ARCHIVES OF OTOLOGY.

OTITIC BRAIN-DISEASE; ITS VARIETIES, DIAGNOSIS, PROGNOSIS, AND TREATMENT, ILLUSTRATED FROM CASES OF THE WRITER'S PRACTICE.[1]

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THE gravity of the extension of inflammatory processes from the ear to the brain has at all times been duly appreciated by the profession, but only during the last decades have their pathology, diagnosis, and treatment been systematically studied. This study has received its chief impulse by the progressive development of operative procedures which in originality of design, boldness of execution, importance of object, and brilliancy of results are unexcelled by the handling of any other group of diseases. The saving of life by evacuating a cerebral abscess or cleansing a sinus filled with pus may certainly be reckoned among the triumphs of modern surgery, but a greater service is rendered to our fellow-men by the general practitioner, and, in particular, the aural specialist, if by timely diagnosis and judicious management of the dangerous forms of ear disease they prevent brain abscess and sinus thrombosis from developing. All suppurative ear diseases may eventually prove fatal by involving the brain. Yet it does not behoove an honest physician to sound the alarm bell at every case of earache or otorrhœa, criminal though it be to neglect either. The warning signal should be given as soon as meningeal irritation is noticed. This being the initial step of otitic brain disease, I shall consider it first, and then suc-

[1] From a paper read before the New York Academy of Medicine, Oct. 6, 1893.

cessively discuss otitic meningitis, extradural suppuration, cerebral and cerebellar abscess, and sinus thrombosis, all of which I am able to illustrate by cases of my own practice. I shall not weary you with detailed clinical histories, but briefly report a certain number of cases to serve as basis of my descriptions and as support of my views.

The chief symptoms of

Meningeal Irritation are:

Headache;

Occasional nausea, vomiting, and dizziness;

Moderate increase of temperature;

Some acceleration of the pulse.

The two latter symptoms, though mostly present, seem to depend more on the virulence of the primary disease, the otitis, than on the meningeal involvement.

Thirst, loss of appetite, and *constipation* are mostly complained of, but they are not characteristic. The percussion of the skull is either painless, or painful only in the nearest vicinity of the ear, namely above and behind the auricle. The differential diagnosis between meningeal irritation and true meningitis is very difficult, and here the practical question, whether, when and how, to operate is of paramount importance. The decision will depend upon a careful examination of the different parts of the ear. The least likely to develop intracranial complications are the cases of *acute catarrhal or suppurative otitis media*, the common otorrhœa, caused by acute rhino-pharyngitis, from exposure, sea-bathing, measles, and scarlet fever. The pain is in the ear and head, aggravated at night, relieved by opiates, leeches, cold applications around the ear, especially the Leiter coil; yet in many cases the warm douche, by a fountain syringe, gives more relief. Before these remedies, with proper cleansing, antiseptics, and rest in bed have been tried, no operation need be considered, for none of the above symptoms is alarming.

In the year 1878[1] I put together all the cases of acute otorrhœa which had come under my care in private practice during the first ten years of my stay in New York. Their

[1] ARCHIVES of OTOL., vol. viii., pp. 1–25.

number was 182, which was 7.2 per cent. of the whole number. There were 4 fatal cases among the 182, *i. e.* 2.17 per cent. This seems a high mortality. I do not know whether the results of my later practice have been more favorable, not having compiled any further statistics. I must say that at that time I was not in favor of much operating on the ear. In the above series of cases I made paracentesis of the drumhead but rarely, and never opened the mastoid. Two of the fatal cases (from meningitis) might possibly have been saved by the latter operation.

The practical question at the beginning of an inflammation of the ear is:

Which, under equal severity of the general symptoms, are the LOCAL CHANGES *that, more than others, give rise to brain complications?* The following two may confidently be pointed out as such:

(*A*) *The attic affections*, and

(*B*) *The perforations at the medial side of the mastoid process.*

A—It is well known now that the inflammations of the cupola-space (attic) are slower to heal and much more dangerous than those of the lower part of the drum cavity, the atrium. The narrow slit which separates the attic from the atrium is readily blocked by the swollen mucous membrane, and it is a matter of record that the pus, even after spontaneous or artificial free perforations of both the membranæ flaccida and tensa, finds no easy outlet into the external ear canal. Seeking another outlet three ways are open:

(*a*) *Upward and outward (laterally) into the pneumatic spaces of the squama, above the ear canal,*

(*b*) *Backward through the antrum into the mastoid process,*

(*c*) *Straight upward through the tegmen tympani into the middle cranial fossa.*

(*a*) The *first category* is well illustrated by the following case:

Acute suppurative inflammation of the attic; paracentesis of the drumhead, spontaneous and artificial perforations of the outer table of the squama; recovery.

J. J. O'Sullivan, thirty years old, of a healthy constitution, contracted a severe cold March 12, 1892. Earache, increasing every day, made him consult me March 16th. I found the drumhead and the adjacent walls of the ear canal intensely red, Shrapnell's membrane bulging. I ordered him an alum gargle, and two leeches and iced compresses behind the ear. The symptoms were not much relieved. Though the drumhead became less red, the upper part continued bulging. On catheterization, I found the tubes open and heard no moist râle. I ordered warm boric-acid water douches for the ear, and as they brought no relief, made a paracentesis in Shrapnell's membrane, and another in the posterior lower part of the drumhead the next day, but liberated no pus. Twelve days after the onset of the affection the ear began to discharge.. Very gentle syringing with warm boric-acid water was ordered. The discharge continued and relief was felt for a few days. Then the discharge stopped, severe earache returned, and was accompanied by violent pain in the head, chiefly around the ear. I tried to bring the discharge on again by steaming and douches with warm boric-acid water. This object was not attained ; on the contrary, the swelling at the upper and posterior parts of the drumhead and adjacent walls of the canal increased, the headache grew most intense, the integument behind and above the ear was swollen, and the angle between the auricle and mastoid obliterated. I made a Wilde's incision down to the bone on April 9th. The pain and swelling in and around the ear diminished for a few days but then returned with increased force. Reopening the previous Wilde's incision, on April 13th, liberated no pus. The swelling and tenderness became more marked above the ear. I therefore extended, on April 15th, the previous incision upward, and evacuated a great quantity of thick pus. The probe discovered rough bone, and penetrated into a cavity fully half an inch directly above the auditory canal. After enlarging the fistulæ with a sharp spoon and curetting the cavity which extended considerably—at least half an inch in every direction—around the opening, I inserted a perforated silver tube. The patient felt better, but as the swelling of the posterior wall at the end of the auditory canal continued, I made, May 5th, a free incision through the bulging upper and posterior part of the membrana tympani and adjacent canal. This incision was followed by a copious hemorrhage, but had apparently no effect, the pus escaping through the drainage-

tube above the ear. The ear canal was syringed and the tube changed once or twice daily. For a few days the whole left side of the face was swollen, the neck remained normal, but behind the ear a fluctuating spot developed, which was incised and a considerable quantity of pus let out.

Headache, sleeplessness, mental depression, and lassitude, but no fever of any account, were the subjective symptoms, more or less marked, during the course of the inflammation.

July 18th the discharge stopped permanently and the tube was left off. July 22d the drumhead was restored, pinkish, the lower part in its natural position, the upper still somewhat bulging. $h = \frac{c}{24}''$; $v = \frac{20}{60}.'$ August 12th, condition good. Sept. 28, 1892, $h = \frac{8}{24}''$; $v = \frac{20}{20}'$: other ear, $h = \frac{24}{24}''$; $v = \frac{20}{20}''$. I saw the patient again three or four months later. He had been free from discomfort, and both ears were normal.

I think this case is quite instructive. An acute coryza extends quickly to the attic. Incisions of Shrapnell's membrane, the membrana tympani proper, and the skin and periosteum of the adjacent portion of the ear canal give no relief, nor does a Wilde's incision behind the ear. The pus, after discharging through the ear canal for a few days, is retained, forms an extensive cavity in the pneumatic spaces above the ear, and breaks through a fistula under the periosteum of the outer surface of the squamous portion. Thorough opening, curetting, and draining of this cavity afford relief, but permanent recovery takes place only after nature has made another opening lower down. Pus may have passed from the upper air-cells into the mastoid antrum, and here produced a perforation at the usual place, but it is just as likely that the pus in the mastoid was the result of a new focus of suppuration, just as in the ear canal we see separate furuncles in different places. It is always advisable to open an abscess where it points, but it is certainly a good rule in all cases of extension of suppuration from the tympanic cavity to open the mastoid antrum, because it is the origin and centre of the system of pneumatic spaces around the ear. Suppuration may start in other places, as in the above case it undoubtedly did, but it usually culminates and ends in the antrum.

(*b*) The *second category* of purulent inflammation of the attic—and the tympanic cavity in general—where the suppuration passes through the antrum into the mastoid process, is the most common. In the majority of cases it ends in recovery after spontaneous perforation of the outer table of the mastoid, forming the well-known post-aural abscess.

This affection is too common to need illustration by reports of cases.

(*c*) The *third category* of *attic affections, that in which the inflammation travels through the tegmen tympani straight upward into the middle cranial fossa* is the most dangerous, though not so frequent as the preceding. The stage of meningeal irritation may pass into real meningitis in a few days and end fatally in one or several weeks. I recall a case communicated at the Am. Ophthalmological Society, which ended in death by meningitis five days after the onset of the earache. A few similar cases are on record. Cases ending fatally within a fortnight are not so rare. A patient, a decrepit man of seventy-one, mentioned in my report spoken of above,[1] died on the 11th day. His symptoms were: pain in ear and head, otorrhœa, walls of ear canal swollen, pulse 120, temp. 99°. The discharge stopped on the 7th day, increased headache and great debility set in and the patient died 4 days later. When the discharge stopped, or even before, the mastoid ought to have been opened.

B—The second group of cases that are distinguished by their gravity and their tendency toward intra-cranial complications is that in which *the pus seeks an outlet through the medial* (*inner*) *side of the mastoid process, the so-called Bezold perforation.* Pus, as every liquid, moves in the direction of the least resistance. It is therefore the anatomical conformation that determines the location of the perforation. When the outer table is thick, the pus breaks either through the anterior wall of the mastoid (the posterior of the meatus) into the ear canal, or through the medial wall of the tip into the digastric fossa, or again it forces its way into the

[1] Arch. of Otol., viii., p. 18.

cranial cavity, be it through the base and attic into the middle, or through the inner table into the posterior fossa.

The cases in which the pus seeks its outlet into the ear canal are rare. The posterior wall of the osseous portion is perforated and the calibre of the canal occluded by pushing the periosteum and skin to the opposite side. The following case is a good example of this variety.

Purulent inflammation of tympanic cavity and mastoid; perforation of osseous wall of canal; deep incision; recovery.

Mrs. K. R., æt. twenty-five, anæmic, had otorrhœa when twelve years old. She consulted me April 6, 1889. Two weeks previously she had violent earache followed by otorrhœa. The purulent discharge was thin, bloody, and copious. Walls of canal so swollen that *Mt* could not be seen. Examination of the discharge for tubercle bacilli negative. Rest in bed, cleansing with a warm solution of boric acid, then warm douches. April 11th, the discharge stopped, the surroundings of the ear became swollen and tender, especially over the mastoid and down the neck. She had pain in and around the ear extending down the neck toward the shoulder. April 18th, has grown very feeble, pain in ear continues. Headache and some fever. A few days later, as the local and general symptoms kept increasing, a deep incision of the swollen posterior wall of the ear canal was decided upon and if it liberated no pus the mastoid was to be opened. The patient being under ether, I made a long incision through the integument of the posterior wall, down to the bone. A great deal of thick pus escaped. I inserted a silver draining tube through which the pus flowed freely for several days, then it gradually diminished and soon ceased altogether. The swelling around the ear disappeared, last that of the mastoid. The recovery, with normal hearing, has been perfect and up to now, three years and a half, there has been no relapse.

This case may fairly be considered as a severe otitis media. Bloody purulent discharge always indicates great intensity of an inflammation. As long as the pus found an outlet through the ear canal there was no great discomfort, but when the discharge stopped the local and general symptoms increased and were relieved as soon as the knife re-es-

tablished a free outlet. The swelling in the canal was uniform, the skin neither red nor tender to the touch as in furuncles. The extension of the swelling and tenderness down the neck, as well as the pain extending toward the shoulder, make it possible that the pus sought and to a certain degree found an outlet at the medial side of the tip of the process, besides through the posterior wall of the canal.

Dr. GUYE, of Amsterdam, recently published a very remarkable case in point.[1] In a man who had a swelling below the tip of the mastoid, from a perforation at its medial wall, he removed, with a ring-knife, a small polypoid granulation from the posterior wall of the osseous meatus, and saw that pus exuded through a fistula in the canal, more abundantly when he pressed upon the mastoid. Some days later an opening was made at the anterior margin of the sterno-cleido-mastoid muscle and a great deal of pus evacuated. Dr. Guye introduced a tube into the opening, and water, injected into it, freely escaped through the above fistula out of the ear. There was facial paralysis in his case. The mastoid was cleansed by daily injections of water through the tube. The patient recovered completely. In our case, it seems that the same condition was preparing, but was prevented from developing so far by a free incision in the ear canal.

A typical and very happy case of this variety is the following :

Attic disease; mastoid and head of sterno-mastoid muscle swollen; large opening of mastoid; recovery.

Anthony Saunders, forty-three years old, of New York, came to me April 20, 1890. He is employed in the repair shops of the elevated railway, and has to go over the tracks, exposed to all kinds of weather. His disease began with dizziness and pain in the left side of the back of his head. He had no coryza at the time. The next day he felt pain in his left ear. This, as well as the headache and dizziness, increased for a week. Then he consulted an aurist, who made a paracentesis of the drum, immediately after which on Valsalva's experiment air whistled through

[1] ARCHIVES OF OTOL., vol. xxi., p. 320.

the ear. The doctor treated him five weeks, "pricking in his ear and drawing blood every now and then" (probably repeated paracentesis). The patient found no relief; on the contrary, the pain in and around his ear, and all over the left side of his head, increased and became so violent, that he thought he could not endure it any longer. Then the doctor said an operation on the bone behind his ear was necessary. The patient consulted with his family physician, who sent him to me. I found there was free discharge from the ear, the walls of the meatus near the drum and the mastoid were swollen. I ordered warm ear baths and a mild astringent. The headache diminished. There were no other symptoms. Two weeks later the picture changed. The discharge stopped, the headache became violent, the swelling of the mastoid increased, and extended down the neck. There was great sensibility to the touch on the mastoid, and the upper part of the sterno-cleido-mastoid muscle. This region was red and hard. There was no nausea, no dizziness, no rise of temperature, as far as feeling with the hand could discover. I told him that an operation was now unavoidable, and should be done without delay. He consented at once, and I performed it before the students at the New York Ophthalmic and Aural Institute, April 8, 1890, stating that it was one of the cases of attic suppuration, where the pus retained in the mastoid was seeking an outlet at the medial wall of the tip, *i. e.*, into the digastric fossa. The proper treatment was not to wait until the perforation had taken place, and the pus was collecting and spreading between the fasciæ of the neck, or extending into the cranial cavity, but to furnish a free outlet for it at once. This should be done, not by tapping the mastoid at its tip, even if the greatest swelling and painfulness were there, but nearest to the source of the pus, the antrum of the mastoid and the attic of the drum.

Accordingly, I opened the mastoid at the level of the upper wall of the ear canal, near the insertion of the auricle, struck pus after having chiselled 4 or 5 *mm* through hard and healthy bone, dilated the opening by the removal of a wedge-shaped piece of bone the broader end at the base, the smaller at the tip of the process. There was an abundance of pus in the antrum and all the accessory cells.

The patient made a rapid and complete recovery. Earache and headache disappeared at once. The discharge from the ear had ceased the next day. The pulse and temperature were nor-

mal. The discharge tube was left off on the twelfth day after the operation. The wound closed on the nineteenth. No tenderness on mastoid. The patient felt well and left the hospital. Three days later he came to the Dispensary feeling well, $h = \frac{1}{24}''$, $v = \frac{20}{60}'$, F A > O. May 15th his hearing was $h = \frac{3}{24}$, $v = \frac{20}{20}-$. October 4, 1892, $h = \frac{6}{24}$, $v = \frac{20}{20}$. Has had no trouble from the ear, continues his former occupation. *Mt* entire, a little dull, with an indrawn scar above the short process of the malleus.

This case was certainly a gratifying example of preventive surgery. Another one of the same kind, but neglected, terminating fatally from cerebral abscesses and sinus thrombosis, will be mentioned later. The specimen showed the perforation on the medial side of the tip of the mastoid.

It is difficult to recognize when meningeal irritation passes over into true

Meningeal Inflammation.

As soon as in the course of otitis media, with its manifold symptoms, the

headache becomes persistent, is followed by
attacks of nausea and vomiting,
dizziness,
drowsiness, delirium, or stupor,
at first acceleration, later retardation of pulse, and rise of temperature,
dry tongue, *thirst*, and *constipation*,

we may be sure that meningitis has begun or is fully developed; the lethal issue is commonly preceded by

spasms in the extremities, and
coma.

When meningitis is imminent, warm ear baths to stimulate the otorrhœa, and cold applications behind the ear, especially by the Leiter coil, day and night, are of service. Anything in the ear canal or tympanic cavity that prevents the escape of the pus should be carefully removed. If in spite of this treatment the cerebral symptoms do not abate, especially if they aggravate and the otorrhœa stops, the

mastoid should be opened. This operation ought not to be delayed, for only in the initial stage can the life of the patient be saved. Even under the continuance of free discharge, the persistent excruciating headache, especially if the mastoid is puffy and tender, makes trephining of the mastoid advisable. I reported such a case before the Am. Otol. Soc. in 1879.[1]

A ship engineer contracted a severe naso-pharyngeal catarrh, followed by earache and otorrhœa. After relief of a few days, return of earache and, while the discharge continued profuse, excruciating headache persisted three weeks. I trephined the mastoid, evacuated pus, and drained the wound. The headache ceased at once and permanently, the membrana tympani was restored in two weeks, the wound in the mastoid closed in four weeks, and the hearing was normal again in six.

It is not at all impossible that in such cases the meningeal irritation is not caused only by congestion and œdema of the adjacent parts, *i. e.*, the meninges over the roof of the tympanic cavity at the floor of the middle cerebral fossa and around the lateral sinus in the occipital fossa, but pus may actually penetrate into the cranial cavity through natural or pathological defects in the bone, or follow the offsets of the dura mater into the attic along the petro-squamous suture or along the walls of perforating blood-vessels. This pus need not necessarily call forth a general meningitis, but may, if by trepanation of the mastoid its source is stopped, become absorbed as hypopyon quickly disappears from the anterior chamber of the eye when the corneal abscess has been burned out or split. In evidence of this proposition I shall, later on, detail the recovery of an undoubted case of extra-dural abscess after opening of the mastoid. If, however, the source of the suppuration is not stopped, the pus penetrating from the ear into the cranial cavity may not all be *pus bonum et laudabile*, *i. e.*, pus in which the microbes are dead, but infective pus as is given off by all acute suppurative processes. In this way the meningeal irritation develops into

[1] *Transactions*, vol. ii., p. 350.

meningitis proper. Cases of this kind are frequent and need not here be exemplified.

Extra-dural Abscess.

This affection has received considerable attention of late. I have seen three marked cases of it, two fatal, with very instructive autopsies. The third ending in recovery. The first has been reported in the *Transactions* of the Am. Otol. Soc. (vol. v., part 1, p. 13). A man of twenty-six had an acute otitis media chiefly in the attic; headache, nausea, dizziness, and some stupor. He came to the hospital a month after the beginning of the trouble, very feeble, with the expression of intense suffering. The dizziness increased and the mastoid was swollen and tender. Three days later I chiselled an elliptical opening into the bone, fully 1 inch deep. Finding no pus, I desisted. Four days later there was free suppuration from the opening and the ear. Temporary relief. Then intense headache, vomiting, chills. Temp. rose from 99° to 105°. Death 23 days after operation. *Autopsy:* Attic full of pus. Purulent lepto-meningitis of the left temporal lobe and the lateral ventricle. Collection of pus on inner side of mastoid, especially in and above the foramen lacerum, separated from the operative wound by a thin layer of healthy bone.

The other, very instructive case was published by me *in extenso* in the year 1883.[1] A very brief abstract is as follows.

Healthy man, æt. thirty-nine, after sea-bathing, August 6, 1882, got pain in the right ear, forehead, and occiput. Drumhead red, upper part bulging. No fever. Mastoid free from any abnormity. Paracentesis, copious discharge; pain relieved. Pain returned in a few weeks, most in right occipital region, where, four weeks later, swelling and fluctuation were discovered. I made an incision through the scalp 6 *cm* behind and 2 *cm* above the level of the ear canal, down to the bone, and liberated a considerable quantity of creamy, inoffensive pus. In the bone, the surface of which in an area of

[1] ARCH. OF OTOLOGY, xii., p. 44.

2.5 *cm* in diameter was denuded but smooth, there was an opening of 4 *mm* in diameter extending into the cranial cavity, as could be ascertained with a probe. A silver drainage tube was inserted, reaching through the fistula into the cranial cavity. For two months his condition was variable, at times he felt well, at others when the discharge through the tube was scant, he had headache, chiefly frontal, nausea, fainting spells, chills, cold and hot perspirations. His pulse varied from 84 to 104, his temperature from 38° C. to 38.8°. At last neuro-retinitis, delirium, convulsive twitchings, and coma set in. Death, January 11, 1883, five months after onset of disease. *Autopsy:* Outer mastoid region healthy, inner table wanting, cavity filled with pus which spread along outer surface of lateral sinus to fistula in bone. Abscess in cerebellum, pus greenish. The temporal bone, removed and carefully examined, showed an unusually narrow communication between mastoid and tympanum.

If in time I had opened the mastoid and secured a free escape of the pus, the life of that man would surely have been saved; but at that time I was not so prepared as I am now to operate on a bone when no outward abnormity could be found.

The third case is a counterpart to this, but *terminated in recovery.*

Mr. R. H. Pettus, colored, æt. twenty-five, had been treated at the Dispensary of the N. Y. Ophthalmic and Aural Institute, by Dr. C. H. May, who on November 27, 1890, opened a postaural abscess and dilated the fistulous opening in the bone, establishing communication with the ear. Admitted to the hospital, the patient came under my care. I will state forthwith that during all his illness, he had almost no fever, and, besides occasional moderate headache, no subjective symptoms. During the first 2 weeks there was free discharge through the ear and the drainage tube in the mastoid. Then the discharge from the latter disappeared, but a fluctuating swelling of the scalp developed 5 *cm* behind and 2 *cm* above the level of the ear canal, in the same locality as in the former case. It was either in or near the lambdoid suture. I incised it, April 16th, and liberated a quantity of pus. Through the integument of 2 *cm* in thickness, the probe passed through

a bone fistula 2 *cm* deeper, finding a membranous, yielding resistance, evidently the dura mater. A drainage tube introduced into the fistula steadily let out a great deal of pus. It was changed two or three times a day. At the beginning of May, there was again some swelling of the mastoid, especially at the tip, which on poulticing disappeared. Patient felt uncomfortable, but had no headache. Toward the end of May, the discharge from the ear and the tube in the occipital bone began to diminish. May 26th, the drainage tube was omitted, the patient left the hospital, and was not seen again until 2 years later, when he came to the dispensary, well and hearty, bringing another patient. He had resumed his former occupation as a porter in a Pullman railway car, and had had no more discomfort from his ear. His drumhead was entire, a little dull, the mastoid showed a linear, the occipital bone an irregular indrawn scar. His hearing was normal.

Remembering the preceding case, I had no doubt that there had been in this one an extra-dural collection of pus, fed from the mastoid cavity perforated on the inner side, travelling along the transverse sulcus to the lambda suture, where it pierced the bone (through an emissary vein?). It might have been proper to enlarge and keep open the fistula in the outer table of the mastoid, but as the free discharge from the ear itself continued uninterruptedly, and there was almost a total absence of grave symptoms, I thought I might leave well enough alone. The happy termination seems to support this theory, but after more extended study and experience in such diseases, I probably shall, in similar cases, lay the mastoid cavity largely open and see that all the pus secreted there flows out, and none into the cranial cavity. Nature has many possibilities, but in the affection under consideration the fortunate outlet of extra-meningeal pus through a new aperture in the cranial bones appears far less frequent than the development of meningitis, thrombophlebitis, and brain abscess. HESSLER, of Halle, in a very instructive paper on the subject,[1] has collected and tabulated 53 cases of this affection (the one published by me in 1883 not only in the ARCH. OF OTOL., but also its German edition,

[1] *Arch. f. Ohrenh.*, xxvii., part 2, p. 87, 1892.

the *Zeitsch. f. Ohrenheilk.*, Bd. xiii., p. 39, has been overlooked), of which 17 cases recovered after an operation. Without an operation, the prognosis thus far had proved fatal in all cases.

Encephalic Abscess

is of frequent occurrence. In about two thirds of the cases the abscess is in the temporo-sphenoidal lobe, in about one fourth in the cerebellum, in 3 or 4 per cent. in both at the same time, exceptionally in the frontal or occipital lobe, in the pons Varolii, the cerebellar peduncles, and the centrum ovale. Otitic abscess of the brain is produced almost always by chronic cases; the symptoms are mostly little characteristic, so that the diagnosis is very difficult. It is produced by lesions of the most different parts of the ear: as a rule, the lesions of the tympanic cavity proper and the attic produce abscess in the temporo-sphenoidal lobe; those of the mastoid, cerebellar abscess. Abscess is usually not the only brain lesion; pachy- and leptomeningitis and sinus-thrombosis are found combined with it, mostly as the consequence of the abscess, not infrequently as its cause—for instance, extra-dural accumulation of pus. The subject has been so extensively discussed during the last years in periodicals and monographs[1] that I abstain from dilating on it here. I beg to refer only to a case of mine which I published *in extenso* in vol. xxi. of the ARCH. OF OTOL., p. 239, 1892. It was a case of attic disease, perforation at the medial side of the tip, mastoiditis purulenta, purulent thrombosis of most of the sinuses and both internal jugular veins, an abscess in the temporo-sphenoidal lobe, another one in the cerebellum, and finally meningitis. I opened the mastoid with temporary relief, and later the cranial cavity in two places, laying the lateral sinus, the cerebellum, and the temporo-sphenoidal lobe bare. Finding no epidural collection of pus, and the dura mater and adjacent layers of the

[1] I may mention the communications of Truckenbrod, Barr, Pritchard, and especially the exhaustive paper by Heimann in these ARCHIVES, v. Bergmann's classical monograph, a readable paper by Piqué and Février in the December number of the *Ann. de l'Oreille*, etc., 1892, and an excellent paper by Frank Allport in the *Journ. Am. Med. Ass.*, October 15 to December 24, 1892.

brain substance healthy, I went no further, because the patient was utterly exhausted. She soon died, and the autopsy showed that the abscesses were at the places where I had opened the skull. The permission to the operation had been given much later than I proposed it. I have spoken in that publication at length on the operation of opening the skull, diagnostic points, and rules for guidance, and so has Dr. Allport in his exhaustive paper, which is based on the statistics of 169 cases of purulent brain deposits, phlebitis and thrombosis following ear disease. He has admitted no case to his synopsis in which the diagnosis was not verified by an autopsy or an operation. How errors of diagnosis are possible, even if the symptoms point with the greatest probability to a brain lesion caused by chronic purulent otitis, is evidenced by a case which I observed last year and reported at the Am. Otological Society,[1] and of which I beg to give an abstract.

A strong man of apparently healthy constitution who had had discharge from his right ear for three years. It had stopped a week before I was consulted. Headache, increase of temperature (101° to 102.25°), with normal pulse, drowsiness, movements of hands, stupor, incoherent and difficult speech, and delirium had set in. His family physician diagnosticated partial meningitis; two eminent neurologists diagnosticated cerebral abscess *ex otitide* and advised craniotomy, so did I when I was called. I was asked to perform the operation. A small quantity of offensive pus was still in the ear. There was no painful place at the head, nor any tenderness or swelling of the mastoid. Percussion not painful. My plan in operating was to remove the outer table of the mastoid, penetrate into the antrum and the tympanic and cranial cavities. The mastoid was sclerosed. Under the outer cortex the bone tissue was blackened in patches and contained a few small cavities, filled with thin pus. Chiselling more deeply, the bone substance appeared healthy, hard, ivory-like, uninterruptedly compact, free from caries and necrosis; it gave no clue in which way the morbid process might have entered the cranial cavity. When the wound was 2 *cm* deep, I proceeded no farther. The patient died three days later. The autopsy showed extensive

[1] *Transactions*, 1892.

tubercular disease of the lungs, pleura, and pericardium, and tubercular meningitis which had no connection with the ear.

Sinus Thrombosis.

The symptoms of this affection are well known: accelerated pulse, high and sometimes rapidly falling and rising temperature, chills, headache, stupor, loss of appetite, constipation. The diagnosis is made sure when besides these symptoms a cord-like or round swelling appears medially and in front of the upper part of the sterno-mastoid muscle, which is hard and painful on pressure and frequently terminates abruptly about 3 *cm* below the jaw. This is the place where the external facial vein empties into the internal jugular. The stream of healthy blood from the facial seems to keep free the calibre in the lower portion of the jugular. The singular phenomenon, so remarkable in the case published by me last year (ARCH. OF OTOL. xxi., p. 239), that the swelling under the lower jaw is intermittent, is explained by the same anatomical fact that the stream from the external facial syphons out the liquefied thrombus in the upper portion of the internal jugular. This portion is then filled again with coagulating blood which in its turn is liquefied and carried off again. When the thrombosis extends into the sinuses of the other side, the same phenomenon may occur in the other internal jugular and be very misleading as to diagnosis, simulating a swollen lymphatic gland. All this occurred in the case just referred to. In the same way the protrusion of the eyeball, of which there are a number of cases on record, in earlier as well as in recent literature, is explained by the thrombosis of the cavernous sinus extending into the ophthalmic vein and its abundant retrobulbar ramifications.

For otitic thrombosis of the cerebral sinuses ligation and cleaning out of the internal jugular vein (the external facial has to be ligated too) and the lateral sinuses have been performed by English and American surgeons (Balance, McEwen, Dean, Barker, Abbe, etc)., and in the successful cases the saving of life has been attributed to the operations on the veins. It is known, however, that sinus

thrombosis and pyæmia may spontaneously be recovered from, and in the following case, which was as clear a case of thrombosis and pyæmia as any, the recovery followed upon an extensive operation on the mastoid without interference with the veins and sinuses.

Marked case of sinus thrombosis and pyæmia cured by an extensive opening of the mastoid.

Mrs. Mary Webster, æt. thirty-three, 165 West 115th Street, New York City, had an earache on the left side after a nasal operation early in May, 1892. Two weeks later the ear discharged. During the next seven weeks she felt better and the otorrhœa gradually diminished, but on July 14th the discharge stopped and violent headache, pain in and behind the ear, set in. The ear canal was swollen, mostly anteriorly. Shrapnell's membrane was bulging. Pain on pressure on tip and below mastoid. Dr. Holden made a paracentesis of the drum which did not liberate pus. She felt relieved for a few days, but on July 22d she came to the Dispensary of the New York Ophthalmic and Aural Institute, complaining of severe pains in ear and head, and vomiting. Pulse 98, temp. 102°. I admitted her to the hospital and made a large paracentesis of the bulging drumhead with the galvano-cautery. She felt some relief for a few days. July 26th her condition was very bad. Her pulse was 108, her temp. 105°. She had violent headache, nausea, dizziness, and stupor. She coughed and her respiration was accelerated. The ear discharged but little, the mastoid was normal, as far as the external aspect was concerned. It was not painful on pressure ; percussion of skull showed no sensitive place. The skin under the ear, however, and the tissue in the retromaxillary fossa were swollen, and along the anterior border of the sterno-mastoid muscle there was a hard painful cord, terminating somewhat abruptly about 3 *cm* under the angle of the lower jaw, where the internal jugular (the hard cord) connects with the facial. The left side of the back of the chest was in places duller than the right, the fremitus vocalis more distinct. There was choked disc in both eyes. I told her brother that his sister was in danger of life, and if anything could still save her it was an immediate operation. He gave his consent and without difficulty persuaded his sister to give hers. I made an incision 5 *cm* long, down to the bone and close to and above the auricle. In the usual way I opened the mastoid with a chisel and extended the

opening with a strong sharp spoon forward and inward. The outer table of the mastoid was healthy. A large quantity of thick pus was in the antrum and cells. I removed a great deal of brittle bone and granulation tissue, until the bony wall felt hard in every direction. The length of this artificial canal which everywhere was bordered by bone, was nearly 5 *cm.* It must, therefore, have penetrated deeply into the petrous portion of the temporal. There was no twitching of the face during the operation, nor any paralysis later. Having in this way thoroughly destroyed the source of the suppuration by cleaning out the cavity, I desisted from going farther, remembering that purulent sinus thrombosis and pyæmia may be recovered from when the source of the suppuration is stopped. The patient soon rallied from the operation. The wound was cleansed and afterwards plugged with corrosive sublimate gauze. It was syringed with clear water once or twice daily. There was no more suppuration, either from the wound, or from the ear. She improved from day to day. The choked disc disappeared in two weeks, the swelling in the retromaxillary fossa in about ten days, but the dulness and the increased fremitus in the left lung much more slowly. The patient was discharged Sept. 2, 1892. Her hearing was $h = \frac{7}{24}$, $v = \frac{20}{20}$—. She was examined again Oct. 4, 1892. With the exception of occasional slight attacks of nausea and occipital pain she has felt well. The wound is closed, the scar considerably drawn in, the drumhead entire, the handle of the malleus and the upper folds are still red, the hearing is good, namely $h = \frac{8}{24}$, $v = \frac{20}{20}$, just as acute as on the other side. Her pale, yellowish color is gradually disappearing and she may be pronounced cured. She was seen again in February, 1893, perfectly well in every respect.

I acted in this case on the principle which I have advocated and followed for years: first and above all remove the source of the suppuration, and then act according to the indications present, or if they are not clear wait for further developments.

I abstain from going into the operative technique of opening the mastoid and the skull, because that is generally known and well described in the text-books of otology and surgery. My purpose in this paper has been to show the most dangerous consequences of inflammatory ear diseases, to dwell on the importance of an early appreciation of these diseases and

to draw attention to valuable diagnostic points, in the deep conviction that, if anywhere prophylaxis is more useful than cure, it is in otitic brain disease.

I have dwelt on the early recognition and treatment of those ear affections that have a tendency, if neglected, to develop brain disease, and I may be pardoned for having repeated many observations that are generally known but which, for the sake of completeness in the presentation of my subject, I did not care to omit ; other parts, I presume, may be read with interest even by the expert otologist, in particular the observations on extradural collections of pus and on sinus thrombosis. My belief is that the aural surgeon should not only be perfectly familiar with the diagnosis and surgical treatment of otitic brain disease, but also be competent and prepared to perform the necessary operations himself.

AN ATTEMPT TO REPLACE AN AURICLE BITTEN OFF IN CHILDHOOD.

By B. ALEX. RANDALL, Philadelphia.

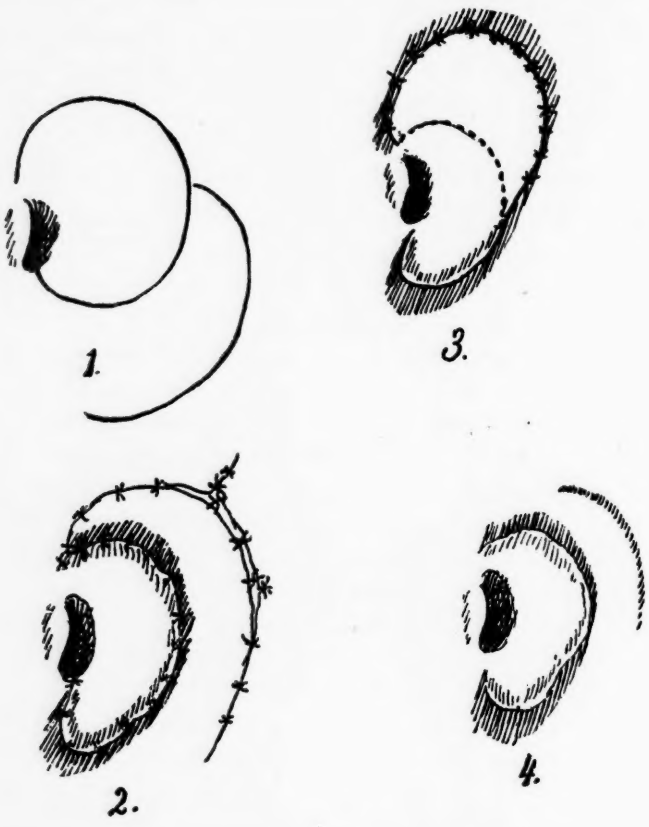
(*With 4 drawings.*)

Martin ——, laborer, Irish, æt. thirty, came to the University Hospital seeking relief from deformity through lack of the left auricle. With misplaced confidence he had "lent his ear" to a companion of his youth, and the dishonest hog had totally made away with it. The hair was arranged to cover the region somewhat; but the lack constituted a particularly hideous deformity, enhanced by the large size of the right auricle. Nothing but the cartilaginous meatus and the tragus remained. A long scar, as though from a burn, extended down along the ramus of the jaw in front; but the hairless area of skin over the mastoid was healthy and ample, so a plastic attempt at building a new auricle seemed justified, although the only cartilaginous tissue available for a flap was that of the auditory canal, and without such support any semblance of an auricle seemed impossible.

Accordingly, on April 4th, under ether, the largest flap possible was cut from the back wall of the auditory canal and turned upward, while the large crescent of hairless skin covering the mastoid and above the canal was dissected up and turned forward to form the back of the new auricle (Fig. 1), its free edge being stitched to the periosteal tissues just behind the meatus. The bare area thus left was reduced in size by stitches in two radiate lines and largely covered by a curved flap extending all the way to the uppermost part of the wound (Fig. 2). A dry dressing was applied over all, with a tampon in the auditory canal to support the displaced cartilaginous tissue and to assist in holding in place the flap forming

the back wall of the canal. Healing was kind and uneventful, and little shrinkage appeared in the three following weeks. All of the stitches had then been removed, the posterior wound was healed and the small auricle-like mass had a good lobule, but hardly rose above the meatus and remained in pitiful contrast to the huge auricle of the other side.

As the patient was pleased with the beginning and anxious to



have further improvement, a second operation was tried. He declined to furnish the needed new tissue from the redundant right auricle, which would probably have been improved by the excision of a liberal wedge, so the cartilage and skin tissues were taken from the ear of a well grown gray rabbit. The part of the new auricle doing duty for helix was unrolled to form, with its whole extent, the front of the future helix, and a graft, obtained by dissecting off the furry outer skin of the rabbit's ear and excising a

nearly circular piece of cartilage and inner skin 40 millimetres in diameter, was placed with its cutaneous surface next to the head to form the hinder surface. This was stitched along the periphery, skin to skin (Fig. 3), and the whole convexity and its inner edge secured partly by deep stitches and partly by a pledget, held by a thread passed through the base of the auricle and tied in front over a roll of lint. A dry iodoform dressing was applied with carefully adjusted pressure. The union of the rabbit skin to the human was prompt and generally perfect; but a little purulent secretion stained the dressing at the rare removals, and the graft shrank steadily away until the condition was almost precisely that before the second operation. Healing was complete and the ear could be left without dressing in four weeks—when the condition was as in the illustration, Fig. 4,—the little rudimentary auricle tending more to overhang the meatus than before, perhaps as the temporary result of the displaced pressure of his last bandage. The cartilaginous tissue derived from the auditory canal seemed to undergo no shrinkage, but was drawn somewhat down into its original place—otherwise the result of the first operation was persistent. The large scar back of the ear was hardly visible except for its pinkish color, but comes out more distinctly in a photograph than does the more conspicuous old lesions in front. The hearing remained at all times practically perfect.

The patient was in excellent health and the conditions generally propitious, so the result probably fairly shows the limitations of plastic surgery under such circumstances; yet it may furnish suggestions to others for some more successful measures.

A CASE OF EPITHELIOMA OF THE AURICLE.

By E. B. DENCH, M.D.

AURAL SURGEON, NEW YORK EYE AND EAR INFIRMARY.

EPITHELIOMA of the auricle is comparatively uncommon, although cases have been observed by Stocken,[1] Schubert,[2] Kipp,[3] Habermann,[4] Moos,[5] Marian,[6] Burnett,[7] Kretschmann,[8] De Rossi,[9] Seely,[10] Buck,[11] and Guermonprez and Cocheril,[12]

I take the liberty of reporting in detail the history of a case of this affection which I operated upon some months since.

Mrs. R., æt. sixty-three, consulted me about five months ago, on account of a discharge from the left ear, which had been present for about six weeks. For the past eight weeks there had been constant and increasing pain in the left ear, gradually extending until it involved the entire left side of the face. Manipulation of the auricle increased the pain, especially when pressure was exerted in front of the tragus. The præauricular region had been swollen for about four or five weeks, and at this time, according to the patient, a mass had been removed from the external canal by means of the curette.

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[1] *Archiv für Ohrenheilk.*, vol. xx., p. 270.
[2] *Ibid.*, vol. xxx., p. 49.
[3] *Transactions of the Amer. Otol. Society*, vol. iii., pt. 3.
[4] *Archiv für Ohrenheilk.*, vol. xviii., p. 76.
[5] *Zeitschr. für Ohrenheilk.*, vol. xiii., p. 66.
[6] *Archiv für Ohrenheilk.*, vol. xxii., p. 212.
[7] *A Treatise on the Ear*, Philadelphia, 1884, p. 234.
[8] *Archiv für Ohrenheilk.*, vol. xxiii., p. 237.
[9] *Archiv für Ohrenheilk.*, vol. xxii., p. 283.
[10] *Transactions of the Amer. Otol. Society*, 1883, p. 118.
[11] *A Manual of Diseases of the Ear*, N. Y., 1889, p. 51.
[12] *Rev. de Laryngol.*, 1892, vol. xii., p. 665.

Examination revealed the surface of the meatus almost completely closed by a firm mass arising from the base of the tragus, upon its internal surface, and involving to some extent the inferior and posterior margins of the meatus. The surface of the growth was ulcerated over a small central area, and was bathed with an offensive discharge, which filled the external auditory meatus. Careful manipulation permitted the introduction of a small speculum, and although the drum membrane could be but imperfectly inspected, the examination satisfied me that no important middle-ear complication was present. The bony canal was perfectly free, and the growth seemed limited to the bony orifice of the meatus, involving chiefly the tragus. Pressure in front of the tragus revealed that this structure was infiltrated throughout its entire thickness, and inspection showed a distinct fulness in this region. There were no enlarged glands, and the mass was entirely movable.

Although the tumor had a decidedly malignant look, the history was so short that it was decided to keep the patient under observation for a few weeks, bearing in mind that a suppurating sebaceous cyst in this region, with secondary perichondritis, might give rise to the local condition. At the end of two weeks the tumor was decidedly larger, and had extended so as to involve the auricle as far as the base of the antitragus, while in the præauricular region the mass had greatly increased in size; the superficial ulceration was also extending rapidly. With the snare, a small fragment was removed, and the microscope revealed the structure characteristic of epithelioma. As the general condition of the patient was daily becoming poorer on account of the severe pain, immediate operation was advised, although the possibility of a recurrence was fully explained.

Operation: The usual antiseptic precautions were observed in preparing the field of operation, and during the execution of the procedure. An incision was made from the superior border of the tragus, forward and downward through the tissues of the cheek, taking care that it should lie well outside the line of induration. The posterior portion of the incision was rapidly deepened until it extended into the meatus, care being taken to avoid opening the temporo-maxillary articulation. From the termination of this horizontal incision, a second was made, extending downward and backward to the insertion of the lobule. The neoplasm was thus included between these incisions, and was completely removed

by careful dissection. A small portion of the parotid gland lying in the lower portion of the wound was also removed, though possibly not diseased. Care was also taken that the section of the cartilaginous meatus should be made through perfectly sound tissue.

As the general condition of the patient did not warrant a prolonged plastic operation, the wound could not be closed completely, though by dissecting up the integument along the two transverse incisions the margins could be approximated throughout two thirds of the extent. When this was done, the lower angle of the wound gaped widely; in order to fill up this space, the tip of the lobule was separated from the auricle, and the flap thus formed was split; in this way a cutaneous flap of considerable size was formed, which when turned forward into the wound, filled the lower angle completely. By dissecting out the cartilage of the antitragus and folding the remnant of the lobule forward and upward, so as to bring the raw surfaces in apposition, a fairly well proportioned auricle remained. The margin of the cartilaginous canal was then secured to the raw surface in front of the meatus by a strong silk suture; this could only be done by stretching the tissues to such a degree that it seemed certain that the suture must cut through in a few hours, but in the hope that the support afforded for this short time might reduce the possibilities of a cicatricial narrowing of the meatus, it was decided to leave the suture in position. There now remained uncovered, an area about $\frac{3}{4}'' \times \frac{1}{2}''$ below and in front of the meatus, and it was decided to allow this to heal by granulation. The wound was dressed with iodoform and bichloride gauze. The recovery was uneventful, healing took place partially by first intention, but in places there was suppuration. The raw surface healed perfectly by granulation, and the auditory canal preserved its normal calibre. There is no evidence of recurrence, and the patient's general condition is much improved.

The growth removed was examined by Dr. Weeks, and found to be an epithelioma.

One of the most interesting features of this case is the rapidity with which the growth developed, requiring removal in about two months after its appearance. Of the cases reported in medical literature Green's [1] case developed

[1] *Transactions of the American Otological Society*, 1870, p. 62.

in eight months, apparently as the sequel of a chronic eczema, while Demarquay[1] and Velpeau[2] cite instances in which the neoplasm appeared first as a simple wart upon the auricle, transformation into a malignant growth resulting apparently from violence, or the application of irritants. Velpeau's case is of special interest, as the growth was upon the tragus, and had attained such dimensions as to demand removal in two months from the time it was first noticed.

Glandular enlargement seems to be an infrequent complication of malignant tumors in this location, the only instances with which I am acquainted being the one reported by De Rossi[3] and one case in my own practice. In the former case, both the parotid and cervical glands were involved; in the latter, only the cervical. In both instances a complete cure followed the removal of the neoplasm and the infiltrated glands.

It would seem, from the study of reported cases, that malignant disease of the external ear is much more amenable to operative interference than the same affection in other portions of the body, and that if the growth is completely excised, before the involvement of surrounding parts renders this impossible, there is every reason to hope for a complete cure.

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[1] *Gaz. des Hôpitaux*, 1869.
[2] *Ibid.*, 1864, p. 106.
[3] *Archiv für Ohrenheilkunde*, vol. xxii., p. 283.

THE HEARING POWER IN DEAF-MUTES; BEING THE RESULTS OF THE EXAMINATION OF 175 DEAF-MUTE CHILDREN.

By JAMES KERR LOVE, M.D.,

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DEAFNESS is almost always relative. A man may be deaf to the tick of his watch but hear conversation; or he may hear nothing of conversation and hear a church bell, or a clap of thunder. Most of us have a little hearing power in reserve, a little to spare. We may become "dull" to a slight extent, and if the dulness be not accompanied by any painful symptom we may be ignorant of its existence till some accident occur to test us. Then we find that the watch is not heard at the full distance; but as long as we can get along without difficulty in business, or in the parlor, or at church, we do not call ourselves deaf.

Moderate degrees of deafness are always measurable. The watch and the various acoumeters enable us to state, with regard to at least one sound of given quality and pitch, the hearing power in any case. A watch heard at 36 inches by a sound ear may be heard at 6 inches by a person hard of hearing, and we are able to state that for that watch the person has lost 50 per cent. of his hearing, or that his hearing is .5, or we may represent his hearing by the fraction $\frac{6}{36}$, always remembering that when thus represented by a vulgar fraction the case looks worse than it really is, for sound diminishes in intensity inversely as the square of the distance. The watch and the acoumeters are accurate as far as they go, but they do not go very far. A deaf person may not hear the watch at all, even in contact with his ear,

and yet hear ordinary conversation quite well, or he may hear the watch at several inches and have much difficulty with conversation. Then watches and acoumeters tell us nothing in the case of very deaf people; they are all unheard. So that, for the very deaf, we have no hearing tests, and, what is worse, we have no accurate nomenclature. When deafness is extreme in early life, or if great deafness be congenital, muteness accompanies it, and we begin to talk of the deaf and dumb. It is true that dumbness is a result of a certain degree of hardness of hearing, that amount of hardness of hearing which makes conversation difficult or impossible, but it is not a necessary result of such hardness. If such deafness occur in the adult, he will never forget the art of speech, and will never be a deaf-mute. If it occur in the child he may be taught by the oral system, and although stone-deaf he may speak well. So that the term deaf-mute does not express any degree of deafness; it never had a very definite meaning, and the oral system has robbed it of some of the meaning it once had. And yet there is a degree of hardness of hearing which makes the acquisition of speech difficult or impossible by the ordinary methods, and which usually results in the loss of recently acquired speech; "Surdism" is the name I would apply to this degree of deafness. It is not measurable by any test we have; but it is sufficiently well defined by this: that it makes the acquisition of speech difficult or impossible, and that by no ordinary method can one communicate with its victim through his auditory nerve.

No acoumeter for this degree of deafness has been devised, and perhaps such an instrument, if invented, would not be of much value. The important query about the very deaf is: Can he distinguish the various sounds of the human voice? If he cannot, he will never speak unless he can make his eyes do duty for his dull ears. If he can, even with difficulty, you may confer on him, or preserve for him, the gift of articulate speech.

In testing the hearing of the very deaf, the victims of surdism, many instruments have been used, and the human voice has almost always been employed. Among instru-

ments—watches, clocks, tuning-forks, and bells may be mentioned. A good synopsis of the results obtained by these tests will be found in Hartmann's book on deaf-mutism, and may be briefly repeated here.

Toynbee classed deaf-mutes under seven different heads. He examined 411 cases.

Totally deaf	245
Clapping of hands heard by	14
Loud shouting heard by	51
Loud voice close to ear heard by	50
Could distinguish and repeat vowels	44
Could repeat short words	6
Could repeat short sentences	1
	411

Amongst these 411 were 313 born deaf, of whom 141 heard certain tones, and 41 repeated vowels pronounced for them. Of the remaining 98 with acquired deafness, 73 were totally deaf, and 25 heard certain tones.

Kramer examined 45 deaf-mutes, and classed them thus:

	Congenital.	Acquired.
Completely deaf	10	13
Uncertain hearing for sound	5	3
Uncertain hearing for vowels	7	1
Distinct hearing for vowels	2	—
Distinct hearing for all words they have been taught	2	1
Distinct hearing for many words not known to them	1	—
	27	18

Hartmann examined 204 deaf-mutes at the Berlin Institution, and classed them thus:

	Congenital.	Acquired.	Uncertain.
Words heard	4	12	—
Vowels heard	6	12	—
Sounds heard	17	39	1
Totally deaf	24	86	3
	51	149	4

Hartmann classes Kramer's examinations and those at the two Baden institutions of Nursburg and Gerlachstein along with his own, and concludes as follows:

"More than one half (60.2 per cent.) of all deaf-mutes are totally deaf. A fourth have hearing for sounds, a seventh hear vowels and words. The difference in the hearing power of congenital deaf-mutes, and of those who have acquired deafness, shows itself principally in the fact that, amongst the latter class the cases of total deafness are far more numerous (68.4 per cent.) than amongst the former (44.2 per cent.)."

De Rossi of Rome examined the hearing of deaf-mutes with speech (through the speaking-tube), and with the tuning-fork (vibrating in the air and on the cranial bones), and with Helmholtz's resonator. He thus tested 70 cases, and states the result as follows:

Speech heard by	27
Watch heard by	4
Tuning-fork vibrating in air heard by	39
	70

In contact with the cranial bones, the tuning-fork was perceived by almost all the deaf-mutes, and there were only 11 who had no perception. He found only 3 cases of total deafness. More recently (in 1884) St. John Roosa of New York examined 147 deaf-mutes. In 1867 he and Dr. George Beard examined 296 cases. The latter set of cases gave but meagre results according to Roosa, the former were examined chiefly for the purpose of ascertaining the locality of the lesion causing the deafness. Roosa used the tuning-fork alone in his tests. I shall notice his work at greater length in a future paper on this subject.

In testing the children at the Glasgow Institution I used:

A large bell,
A large tuning-fork,
Politzer's acoumeter,
The human voice.

Of these, the last is the most valuable test, and where the classification of deaf-mutes for teaching purposes is the object in view, is almost the only test worth using. When testing with the voice, precautions must be taken against

lip-reading. All very deaf people lip-read to some extent, and semi-mutes, even when untaught, lip-read to a very great extent. I pronounced the test words or vowels either behind the child's back, or I covered his eyes with my hand. Next in importance come the bell and fork. For determining the presence or absence of aërial hearing, the bell is the best test. Where any doubt on the point existed the child was made to count the strokes, which were delivered singly and at short intervals. Here too the eyes were covered during the test. The bell used was a large dinner-bell with a spring tongue attached at the junction of the handle and the bell, and so arranged that a violent shake produced a sound of great intensity. A little practice enables the operator to produce sounds of very uniform loudness. In the open air, at the Queen's Park, near Glasgow, the bell could be heard at a distance of nearly 1,000 yards.

The tuning-fork is a large one of about ten inches long, including the handle, and giving a note due to a vibration of 330. Although a powerful fork, it takes a good ear to hear it across an ordinary room by aërial conduction; and yet I met with instances of deaf-mutes who heard this fork at several inches from the ear, and who could not be made to hear the loudest strokes of the bell. But the fork is most useful for testing bone-conduction, and thus indicating the situation of the lesion causing the deafness. Although this is the special value of the tuning-fork, its usefulness is very limited. In very deaf people, when the handle is placed on the forehead, or over the mastoid, the mechanical vibration communicated to the skull is often mistaken for sound, and unless the deaf-mute be very intelligent and well-educated, one cannot be sure that he has heard the sound. He may only have felt the tremor. It requires a deaf-mute of more than the average intelligence to appreciate the tapering off and cessation of a sound produced during a bone-conduction experiment, or to compare the results of experiments on his two ears. These difficulties and the fact that the lesion is probably in many cases one which affects both internal and middle ears, render an exact diagnosis of its seat very difficult, and, in my opinion, only possible in a minority of

cases; the presence or absence of bone-conducting hearing can generally be ascertained, but the amount of it is not usually measurable.

The acoumeter is the least important of the test instruments. I used it in my first hundred cases, mostly educated deaf-mutes, and then gave it up as being of little value, except in the case of semi-mutes with a large remnant of hearing, the amount of which it was desirable to measure accurately. I used it in testing both aërial and bone-conduction hearing. Twelve heard it aërially.

Throughout the whole of the work I was assisted by Mr. W. H. Addison, the principal of the institution, and have to notice not only his great kindness and helpfulness, but his thorough appreciation of the scientific value of the investigation. In all, 175 children were examined. In classifying them a distinction has to be made between the educated and the uneducated. An uneducated deaf-mute cannot describe his experience of a test like this; he has no finger language, his sign language is of the vaguest; he may hear a loud sound quite well, but he cannot imitate it. Unless he have a large residue of hearing and be only a semi-mute,[1] his testing cannot be relied on until he be about a year under tuition. Forty-nine of the whole number of 175 were thus disqualified because of inability to appreciate or reply to the tests. Three were found to hear perfectly, and to have their muteness due to some other cause than deafness. The remaining 123 were thus classified:

I. Stone deaf—hearing neither the bell nor the loudest shouting, nor the tuning-fork sounding in the air.....	9
II. Could hear and more or less distinguish the loudest sounds, *e. g.* the voice from the bell.....	81
III. Could hear and distinguish the sounds of the human voice.....	33
	123

[1] In the above, the term semi-mute is to be taken as meaning those whose remaining speech depends on their remaining hearing. They might have been called semi-deaf. The term semi-mute is sometimes applied to a different set of cases: those whose remaining speech is entirely a recollection of what they once heard, although they may now be stone deaf. The acoustic method is of course not applicable to them.

These latter 33 were found to consist of 20 who could hear and distinguish vowels only, 13 who could hear and distinguish vowels, consonants, and some words.

14 cases were quite deaf to the bell. Of these 5 heard the fork by aërial conduction, leaving 9 totally deaf.

Further, of the whole number (123) 80 heard the fork by aërial conduction, and 43 did not. The fork was appreciated by bone-conduction in almost every case, even where no aërial sound was heard. If this sensation were always hearing, and not mere tremor, the number of deaf-mutes who have no hearing would be very small indeed, but I have included as totally deaf all that have no aërial hearing.

From the above it will be inferred that the number of totally deaf is very small (about 7 1-2 per cent.) amongst deaf-mutes. In the second class are found the bulk of deaf-mute children (81 in 123, or about 65 per cent.). These hear and distinguish very loud noises, but cannot differentiate the various sounds of the voice.

The third class contains over a quarter of the children (33 in 123, or about 27 per cent.). Thirteen of these children would hear something of what their fellow-men say to them, if the latter would say it loudly and distinctly enough; that is perhaps too much to expect from the world. But they are seldom or never properly dealt with. Remember that these thirteen children can hear, distinguish, and repeat without lip-reading, consonants and some words. They are not dumb. They are sent to our deaf-mute institutions, and I have the strongest proof that most of these children become much deafer, and very soon quite dumb. Nothing is done to stimulate their auditory apparatus, and it gradually falls asleep, never again to wake. The proof I refer to is this. The thirteen children are drawn from all ages in the Institution, but not equally so. Ten were found among the 75 children admitted during the last two years. Only three existed amongst the 100 children admitted before that period. Nearly two years ago I had evidence of quite a different sort, pointing in the same direction. When first going over the children, I found several quite deaf to consonants and words, and even to vowels, who were described in

the schedule report as having, at the date of admission, a good deal of hearing and a little speech. The schedule is usually filled up under the supervision of a medical man, and is usually correct. The conclusion is inevitable. Semi-mutes become deafer and totally mute, because no effort is made to preserve and develop their remaining hearing. This is not as it should be. Either these children should never enter an institution for the deaf and dumb, or special classes should be made for them, and teaching by the aural or acoustic method adopted. To teach them the finger method is to consign them to a world of silence. The oral method does not meet the case either. It may accustom the child to hear his own voice by bone-conduction, but it does very little to preserve his hearing for the sounds of the world around him. If the remaining hearing is to be preserved and developed, the stimulus must reach the auditory nerve by the ordinary channel, and the stimulus must consist of the distinctly articulated words of a teacher, and not merely of the imperfect imitations of the pupil himself.

Anticipating the subject of the causes of deaf-mutism, it may here be noticed, that of the 9 totally deaf, 7 were born deaf, and 2 were born hearing (as reported in the schedules). Of the 33 who distinguished voice sounds, 8 are said to have been born deaf, 20 born hearing, and regarding the remaining 5, doubt is expressed or information is not given.

Comparing these results and those of other observers, I find myself in accord with De Rossi in regard to the main points raised.

1. Total deafness is very rare among deaf-mutes. For aërial sounds it is not greater than 7 or 8 per cent., for bone-conduction sounds, even less.

2. Hearing for speech is pretty common. It exists to a utilizable extent in 25 or 27 per cent. of deaf-mutes, and from 10 to 15 per cent. are only semi-mute. Under the finger system of teaching these semi-mutes become rapidly deafer, and soon totally dumb. The oral system may do something to prevent this, but it can only be properly dealt with by the acoustic method.

3. Cranial conduction exists in almost all cases, and a large vibrating tuning-fork is almost always heard in this way. It is also heard in the majority of cases by aërial conduction. In a small number of cases can such sounds as those of a watch, or Politzer's acoumeter be heard. On the other hand, I am much at variance with Toynbee and Hartmann, who found most deaf-mutes totally deaf. Hartmann's further statement, that total deafness is commoner in acquired than congenital deafness, does not coincide with my experience. Most of those examined by me and found to have hearing for vowels, consonants, and words, were cases of acquired deafness. Only two of my nine cases of total deafness were said to have been born hearing.

I cannot altogether explain these differences. The absence of a standard test and a uniform method may account for them, but their existence makes the detailed description of instruments and methods given in this paper, very important.

THE BEST BEND OF SHAFT AND HANDLE IN INSTRUMENTS FOR OPERATION IN THE DEPTH OF THE EAR CANAL.

By ROBERT BARCLAY, A.M., M.D., St. Louis, Mo.

(*With a wood-engraving.*)

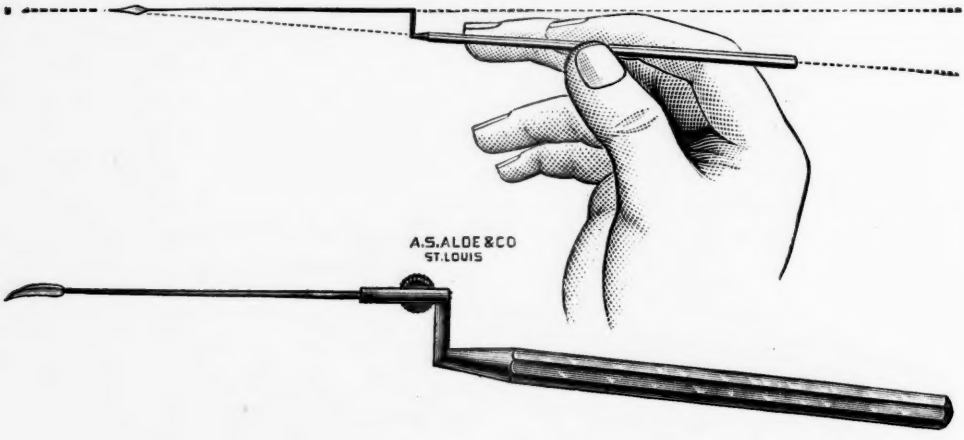
The necessity for the most delicate and accurate manipulation of instruments in operations upon the deeper external auditory canal, drum-head, and tympanic structures, and the extreme difficulty, if not impossibility, of satisfying it with aural instruments having shaft and handle of the existent patterns,—straight, bent (as at 110°), and twice-bent (as in the double-curette),—which are fundamentally unsuitable for this service, have provoked an attempt to devise a shaft and handle so proportioned as to combine the desirable features of those already in use, without their respective defects and faults.

The result is the instrument (see Fig.) described below, which affords a maximum of vision, of illumination, of mechanical effectiveness, of manipulative convenience and manual control, of economy of expense and space, and of adaptability to surgical instruments for narrow cavities.

The essential features of the new instrument are these: the aluminium handle is of dimensions and weight most favorable to delicate and accurate manipulation. Its long axis passes directly through *the operative extremity of the operating shaft*, which is, therefore, as in a straight instrument, *wholly under control*, and can be made to operate at will, *in any direction*, rectilinearly or curvilinearly, or to rotate without displacement.

The handle is joined to the operating shaft by a lateral shaft, of length only sufficient to permit, in operation, the greatest illumination and vision along and beyond the operating shaft. For an operator whose finger-tips are uncommonly slender, or who handles the instrument with his finger-tips, this lateral shaft may with advantage be constructed somewhat shorter than usual.

The operating shaft is of the smallest dimensions permissible under the operative requirements, and is at right angles to the lateral shaft, thereby enabling the operator to hold the handle as near as possible to his work and to operate with a finger rest. If the reflection of light from the lateral



shaft be annoying to an operator, he can avoid this by having the lateral shaft made at an *obtuse* angle to the operating shaft, which will deflect the rays of light. This will, however, place the handle somewhat further from the operative extremity.

If desired, the shaft and handle may be constructed separately, and adjustable, with socket and set-screw, so that with one handle may be used, as required, shafts having dissimilar operative extremities. The instrument may be constructed of any size, material, or operative character, as desired, for aural, nasal, or other orificial surgery.

It is hoped that this fundamental modification of our instruments may prove a step in the right direction, and be

suggestive to otologists generally in search of the perfect aural instrument.

For valuable assistance in perfecting the instrument, I desire, in conclusion, to make grateful mention of Messrs. A. S. Aloe & Co., of St. Louis, who have also pledged themselves to construct it—unless ordered otherwise—of material and pattern in strict accordance with my design.

3211 Lucas Ave.

A CASE OF THROMBOSIS OF THE LATERAL SINUS.

By JOHN L. ADAMS, M.D.,

ATTENDING SURGEON TO THE NEW YORK EYE AND EAR INFIRMARY AND TO ST. BARTHOLOMEW'S NIGHT DISPENSARY FOR DISEASES OF THE EYE, EAR, NOSE, AND THROAT.

AMONG the numerous cases which present themselves to the ear specialist there is none perhaps so rare as that of thrombosis of the lateral sinus.

Is this due to the fact that patients do not refer the trouble to the ear or that the diagnosis is difficult?

The limited number of cases heretofore operated on have given us very unsatisfactory if not perplexing symptoms.

The citing of this case may be of interest from the fact that the only pronounced symptoms were those of increased temperature on the side of the head affected, papillitis, and temperature fluctuation.

In my opinion troubles secondary to ear diseases should come into the province of aural surgery, and I think if such were the case mortality from extension of middle-ear affections would be very greatly diminished.

Without encroaching upon the domain of brain surgery, I believe this to be a great field and one which should be more carefully investigated by the aurist.

It has been proved repeatedly that exposing the lateral sinus has been attended in the majority of cases with no evil results. It therefore seems that where sinus thrombosis is to any degree suspected, an exploratory operation should be made, laying bare the sinus in order to discover if the wall is at all affected.

Admitting the feasability of such an operation, would not

the chances of success be greatly influenced by prompt action before the clot had so permanently formed as to withstand moderate irrigation?

In the case before us the clot extended from near the torcular Herophili to the exit, from the skull, of the jugular vein.

The moderate irrigation used in this case removed only a small portion of the clot (about an inch in length), leaving the remainder as a nidus for septic infection through the now open wound.

Had the patient, on her first visit at my clinic, consented to an exploratory operation, we would probably have found the sinus affected, but not to such an extent as to have involved the adjacent tissues.

Lena K., aged twenty years, on February 2d, first presented herself at my clinic at the New York Eye and Ear Infirmary, complaining of pain in the right ear and right side of the head. Examination showed slight amount of secretion in the external auditory canal, the canal itself being swollen. Membrana tympani thickened and perforated in the posterior inferior quadrant. Tenderness very marked over the mastoid process, slight induration. Temperature 101.2°, pulse 76. Patient considerably prostrated and complained of pain when she moved her head quickly. No swelling or tenderness found in neck below mastoid process. I advised her to come into the hospital immediately and warned her of the dangers of delay. She refused, however, saying she did not think she was sick enough, and preferred to be treated at home by her own physician. Her physician, after treating her a few days, advised her to return. On February 6th she came again to my clinic and was admitted to the hospital. She was at this time supported by her husband and brother, as she was not able to stand alone.

On admission. Previous history:

In November, 1891, had profuse discharge from right ear, which lasted for one week; this was followed by continuous slight discharge until four weeks ago, when it entirely ceased. Three months ago her hair came out to a great extent on anterior part of scalp and an eruption was at this time noticed on her chest and neck. No sore throat. She was given specific treatment internally, also local medication. Married three years but has had no children. No specific history on husband's side. Always healthy

previous to her marriage, since then has had uterine trouble, (leucorrhœa). Seventeen days ago began to have headaches. Ten days ago the right ear and right side of her head began to be painful. This condition has become gradually worse until the present time. Has had repeated attacks of shivering and vomiting.

Feb. 6th—Examination :

Marked mastoid tenderness with slight induration. Small amount of pus found in external auditory canal. Canal swollen. Perforation in membrana tympani at posterior inferior quadrant. Temperature 101°, pulse 78. Pain experienced at back of neck upon moving the head. Severe headache, referred to right side of the head. Patient is unable to hold her head up, but rests it upon her husband's arm, nor is she able to stand without assistance.

Feb. 6th—operation ; ether.

The hair in the region of the mastoid was removed with a razor. Skin was well washed with a solution of bichloride of mercury 1 to 5000. An incision was then made over the mastoid region from the tip to an inch above the upper attachment of the auricle. An opening was made into the antrum by means of a gouge and mallet. A small quantity of pus was found in mastoid cells. Otherwise the bone was apparently healthy. Free drainage was established with the middle ear and a current between the wound and the external auditory canal was procured. Wound was thoroughly cleansed with a solution of bichloride of mercury 1 to 5000, packed with iodoform gauze, and the usual dressings applied.

Feb. 7, 1893. Patient noticed to have convergent squint. Paresis of right sixth nerve. Diplopia upon carrying objects into right field. Hyperæmia of both optic discs.

Temp. 100.4°. Pulse 70. 9 A.M.
Temp. 100.4°. Pulse 78. 1 P.M.
Temp. 103.5°. Pulse 78. 6½ P.M.

Ice cap ordered, and magnes. sulph., drachm every hour.

Feb. 8th. Patient has severe chill at 7 A.M.; ice cap was discontinued. During night, severe pain in head almost continuously. No facial paralysis. Pupil reacts to light stimulus.

9 A.M. Temp. 104.5°. Pulse 88.
11 A.M. Temp. 102.5°. Pulse 84.
3 P.M. Temp. 99.8°. Ice cap reapplied.
5½ P.M. Temp. 104.5°. Pulse 80.
11 P.M. Temp. 101.4°. Pulse 78. Resp. 26.

The sudden fluctuation of temperature subsequent to the operation suggested to me the probability of deep-seated pus formation, and therefore Drs. Bull, Starr and Vought were called in consultation.

Examined by Dr. Bull. Paresis of right sixth nerve. Beginning papillitis in left disc. Hyperæmia of right disc.

Examined by Dr. Vought. No apparent paresis except right sixth nerve. Reflexes normal. Pain in back of neck on pressure and when she moves. Some rigidity of muscles of back of neck.

Examined by Dr. Starr. Patient lying on back with thighs flexed on abdomen. Temperature on abdomen 103°. Pulse 108. Head turned to left side. Very slight movement of head causes severe pain and rigidity of muscles in posterior part of neck. Surface thermometers applied to scalp in same position on each side, for same length of time register 1° higher on the right side, than on the left. Paresis of right sixth nerve. No diminution in sensation anywhere. Reflexes the same on both sides of body.

Patient stupid and has to be roused to converse intelligently. Percussion on scalp elicits no tenderness anywhere. No œdema of neck or in region of jugular vein. Handling of patient and quick impressions (light), etc., do not cause any pain. Mental condition dull and somnolent, but when roused apparently intelligent and capable of answering questions correctly.

Diagnosis by Dr. Starr. Abscess of brain. Probably in temporo-sphenoidal lobe, possibly in cerebellum.

Just before the operation, the question of diagnosis being under consideration, Dr. Gruening expressed the opinion that the rapid alternations of temperature and the early development of choked disc were indicative of sinus thrombosis rather than of an abscess.

Ice cap during night. Slept from 12 to 2 A.M. and from 3½ to 6¼ A.M. Pain in head continually during the night. No chill.

4.15 A.M. Pulse 85. Resp. 20. Temp. 101.4°.

7 A.M. Pulse 94. Resp. 35. Temp. 101.2°.

8½ A.M. Pulse 96. Resp. 30. Temp. 102°.

Diagnosis by the brain specialists being abscess of the brain and the case being no longer in my province the general surgeon was called upon to operate.

Feb. 9th. 1.20 P.M. Operation by Dr. Abbé.

Opening made in skull. Centre of trephine was 1¼″ behind external auditory meatus, along Reid's line and 1½″ above. Circle of bone removed. Dura found pulsating and unusually full,

traversed by two large veins requiring enlargement of bone, opening ¾″ in order to secure free dural tissue. Opening curvilinear ¾″ in dura, brain substance pouted badly. Needle passed 1¾″ to 2″ in every direction. No pus found. Dura sutured (continuously) with fine catgut. Wound closed. Catgut sutures. Lateral sinus was then exposed by extending mastoid wound backwards. Sinus found faintly pulsating, thickened, and inflamed. Foul plum-colored venous blood withdrawn at this point from sinus. The internal jugular was then ligated in the neck and cut between the two ligatures below the junction of the external facial with it. The external facial had been tied first. When the ligature was removed from the upper end of the cut jugular, blood came with moderate force showing open petrosal sinus. Ligature reapplied and wound packed. Lateral sinus freely incised (1 inch). Foul septic thrombus found, which was cleaned out. After the lateral sinus was irrigated, there was some hemorrhage from it. Wound was then packed and dressed.

Operation lasted 2¼ hours. Ether anæsthesia. 9 P.M., temp. 98.9°. Pulse 104. Resp. 22. Slept from 7.15 to 8 P.M. Complaining of sore throat. Unable to swallow easily. Pain in stomach continually. Mustard poultice applied.

Feb. 10th. 12 M. Temp. 99.4°. Pulse 109. Resp. 25.

3 A.M. Temp. 100.2°. Pulse 108. Resp. 26.

7 A.M. Temp. 99°. Pulse 85. Resp. 24.

Took 3 glasses of milk during the night. Slept from 6.30 A.M. to 8 A. M.

11.30 A.M. Temp. 99°. Pulse 122. Resp. 27.

Took 2 glasses of milk and some vichy this A.M. Wound in mastoid dressed without disturbing other wounds. No odor. Repacked with iodoform gauze. No delirium since operation; no chill.

3.20 P.M. Temp. 100°. Pulse 132. Enema. Poultice over epigastrium.

8 P.M. Temp. 99°. Pulse 85. Resp. 22.

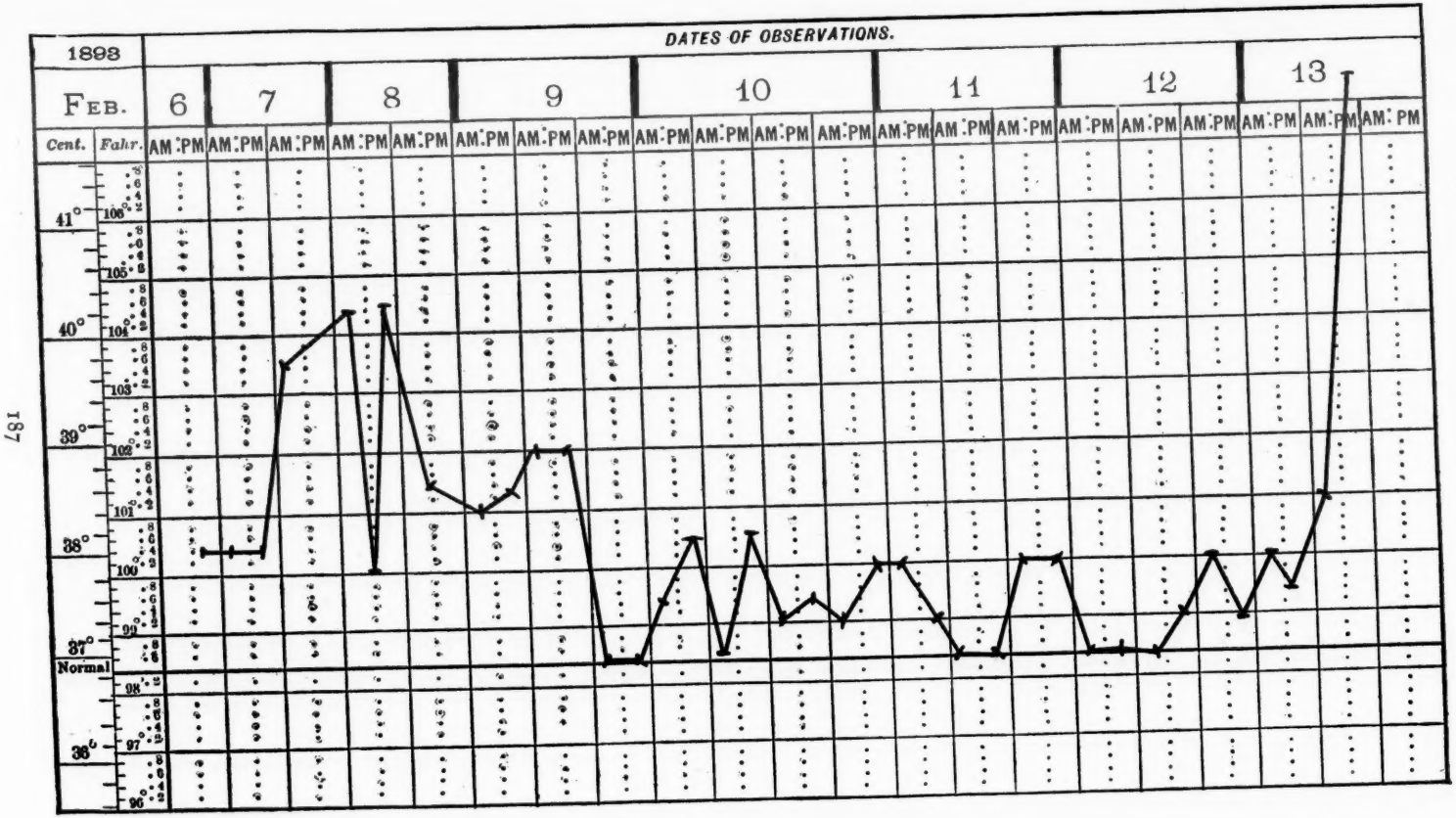
Milk 3 oz. Milk and vichy 3 oz. taken.

12 M. Temp. 100.2°. Pulse 114. Resp. 24.

Feb. 11th. 4.30 A.M. Temp. 100°. Pulse 110. Resp. 22.

11 A.M. Temp. 98.2°. Pulse 124. Resp. 23.

Patient had some delirium during the night. Pulse full and strong. Has taken milk and whiskey frequently. Ice cap kept on. Slept 3½ hours during night. Complained of pain in head.


1893
DATES OF OBSERVATIONS.
FEB.
6
7
8
9
10
11
12
13
Cent.
Fahr.
AM PM
41°
106°
105°
40°
104°
103°
39°
102°
101°
38°
100°
99°
37°
Normal
98°
36°
97°
96°

2 P.M. Temp. 99°. Pulse 130. Resp. 20.
4 P.M. Temp. 98°. Pulse 120. Resp. 22.
6 P.M. Temp. 98.2°. Pulse 116. Resp. 25.
10 P.M. Temp. 100°. Pulse 124. Resp. 24.
12 M. Temp. 100°. Pulse 124. Resp. 23.

Wound dressed. Mastoid wound has odor, others have none. Patient had some delirium during the day. Two hours' sleep during day. Has taken a moderate amount of nourishment in shape of chicken broth, milk, and whiskey. Restless, but no delirium during evening. (Enema.)

Feb. 12th.

4 A.M. Temp. 99°. Pulse 118. Resp. 22.
10 A.M. Temp. 98.2°. Pulse 124. Resp. 23.

Slept fairly during the night. Ice cap kept on head. Is not taking her nourishment quite so well.

4 P.M. Wounds dressed. Odor from mastoid wound, which was cleansed thoroughly before exposing other wounds. Wound in scalp apparently healed, but there is some apparent puffiness, I thought it best to open it again. Found to have some blood clot in it. Wound washed and piece of iodoform gauze put under flap.

Wound in neck dressed. No suppuration. Ligature on facial vein removed. Whole of wounds dressed. Bandage applied.

3 P.M. Temp. 98.2°. Pulse 124. Resp. 23.

Has slept three hours during the day. Has taken nourishment fairly.

6 P.M. Temp. 99.2°. Pulse 120. Resp. 22.
8 P.M. Temp. 100°. Pulse 120. Resp. 22.
12 M. Temp. 99°. Pulse 121. Resp. 20.

Feb. 13, 1893.—Patient slept 2½ hours during the night. Ice bag kept constantly applied. Moaned all night and complained of pain in head. Delirious early in morning.

4 A.M. Temp. 100°. Pulse 122. Resp. 22.
3 P.M. Temp. 102°. Pulse 148. Resp. 20.

11 A.M. Wounds dressed. Some odor in mastoid wound. No odor or suppuration in other wounds. Patient appears more stupid to-day. Has taken scarcely any nourishment since yesterday morning. Anæsthesia of pharynx complete. Cannot swallow.

2 P.M. Patient had sudden change for the worse. She became

semi-comatose; pulse much weaker. 3 P.M. Comatose. Pulse very weak, respiration labored.

5 P.M. Comatose. Resp. slow. Pulse 160°. 5:45 P.M. Temp. 107.2°. 6:05 P.M. died.

11 P.M. Autopsy by Dr. Weeks. Rigor mortis slightly marked. Curved incision through scalp 5 *cm* in length, extending from upper to lower border of auricle 1 *cm* back of insertion of auricle. T-shaped incision through scalp beginning $5\frac{1}{2}$ *cm* from the lobe of the auricle, on a line extending from the lobe to the occipital protuberance, passing upwards for a distance of 6 *cm* in the direction of the bregma. Incision $2\frac{1}{2}$ *cm* long, extending backwards from this incision. With the exception of some infiltration of blood in the region of the wound the scalp was normal. The trephine opening through the skull $2\frac{1}{2}$ *cm* in diameter, which passed through the post. quadrant of the parietal bone just above its groove for lateral sinus, was filled partly with clot and partly with brain substance, which protruded 5 *mm* beyond the surface. On removing the calvarium the veins of the pia were found engorged. There was an opening through the dura, corresponding to the trephine opening through the skull, but smaller. No excess of cerebro-spinal fluid. Right superior and posterior inferior petrosal sinuses engorged.

Right lateral sinus partly filled with a fibrinous light-red clot, which extends into inferior petrosal sinus and internal jugular. This clot was probably of anti-mortem formation. Some sanguino-purulent fluid escaped from the lateral sinus when it was opened. Cerebrum normal, except at a point opposite an opening in skull where the brain tissue was lacerated over an area of 1 *cm* in diameter, extending 1 *cm* into brain substance. Some small cavities filled with blood were observed passing in various directions from this point. No pus. Left half of cerebellum normal.

Right half of cerebellum: two thirds of superior surface of the cerebellum lying next to the median line was covered with thick pus, extending forward to crus cerebelli. There was a shallow depression of the post. part of the right lobe, measuring $5\frac{1}{2}$ *cm* transversely and $1\frac{3}{4}$ *cm* vertically, which

contained thick pus lying between pia and dura. The depression extended forward just far enough to reach the opening made through the skull from the mastoid process at the groove for the lateral sinus. The tentorium and dura of cerebellar fossa, corresponding with the area of purulent deposit on the cerebellum, were also covered with pus. There was an opening through the dura into the cerebellar fossa, large enough to permit of the passage of a grooved director at a point corresponding to the opening through the skull, from the mastoid cells. This opening communicated with the lateral sinus. No other opening existed.

Two thirds of petrous portion of temporal bone was removed. A mass of thick purulent material was found in the posterior part of the tympanum, lying against the bone. The bone here was discolored, the discoloration extending through the post. wall of the petrous portion at a point corresponding to the union of the inferior petrosal sinus with the lateral sinus. There was evidently some infiltration of the bone tissue with pus.

Death resulted probably from circumscribed suppurating meningitis, caused by purulent infiltration from middle-ear disease.

THE PROPAGATION OF AFFECTIONS OF THE TYMPANUM THROUGH THE CAROTID CANAL INTO THE CEREBRAL CAVITY.

By DR. OTTO KOERNER, Frankfort on-the-Maine.

Translated by Dr. Max Toeplitz, New York.

ONE or two small canals (canaliculi carotico-tympanici), as is well known, pass through the osseous wall, separating the carotid canal from the tympanic cavity. A portion of the tympanic mucous membrane receives through these some nutrient vessels directly from the trunk of the carotid. Furthermore, small veins pass in the same path from the tympanic cavity to the venous plexus, surrounding the carotid within its canal, and connected with the sinus cavernosus (*Rectorzik*[1]). In some instances the osseous wall between the carotid and tympanum is as thin as paper and exhibits holes for the vessels instead of canals. The walls contain not infrequently small, in some instances very large, interstices (spontaneous dehiscences), which allow the carotid walls to adjoin the tympanic mucous membrane in their entire extent. I have found in two skulls such interstices, which were so large and so situated as to render an injury to the carotid in paracentesis of the membrana tympani quite possible.[2]

If we consider how frequently pus reaches the cerebral cavity from the tympanum by other existing paths or by those formed by pathological destruction of the bone, we are really astonished, that the knowledge of the extension of inflammations from the tympanum to the adjoining carotid canal and through this to the cerebrum is limited and is

scattered through medical literature. The most important of these observations are found in the foreign, non-otological literature and are thus unknown to the authors of our text- and hand-books on otology.

It is quite proper, therefore, to unite briefly *in one place* all statements of these relations. I may succeed in drawing the attention of aurists for autopsies in this neglected region. One or the other colleague may increase our knowledge upon the subject by adding further notes on the literature.

Even *in simple suppurative inflammation of the mucous membrane of the middle ear* (without affection of the bone), *Gruber* not infrequently found *purulent exudate in the carotid canal* and purulent infiltration of the adventitious membrane of the carotid artery.[3]

If the osseous wall of the canal is pathologically destroyed, most frequently in tuberculous and specific affections, *osseous pus*, of course, *reaches the canal.* It surrounds the lymph vessels and the above-mentioned venous plexus.

The *lymph vessels*, leaving the skull through the carotid canal, originate partly along the ophthalmic artery from the eye and from the adjoining tissue of the optic nerve. When surrounded by pus, they may be inflamed and thrombosed. *Barker*[4] believes that congestion of lymph, developed in this way, may lead to *swelling of the papilla nervi optici.* According to this author, the not infrequent occurrence of *"choked disk" in simple aural suppuration* without intracranial complications is explained in that manner.

The venous plexus connected with the cavernous sinus may also be affected by the presence of pus in the carotid canal. This affection may be propagated into the cavernous (lateral) sinus. *Styx*[5] has described a case with symptoms of thrombosis of the lateral sinus, which arose by extension of inflammation from the ear to the contents of the carotid canal. It was a relapsing otitis media with general cerebral symptoms (fever, headache, vomiting, and constipation). In the third week, paralysis of the nervus abducens, passing through the lateral sinus, and choked disc in the side corresponding with the diseased ear, supervened. *Keller*[6]

also observed in retention of pus in the tympanum with pyæmic symptoms, simultaneous paralysis of abducens and papillitis nervi optici (bilateral). It is true, that it has not been demonstrated in any of these cases, that the affection had extended through the carotid canal to the lateral sinus, but the resemblance of both cases, particularly the simultaneous presence of papillitis and paralysis n. abducens, which are explained by the propagation of inflammation along the carotid, are in favor of *Styx's* view.

Gruber found, with reference to the *affection of the carotid itself*, as mentioned above, in suppuration of the tympanum, *purulent infiltration of the carotid wall; tubercles in the adventitious layer* were found by *Habermann*.[7]

Erosion of the carotid wall and the *fatal hemorrhages* resulting therefrom may be but briefly mentioned, since these conditions are sufficiently known by two elaborate papers published by *Marcé*[8] (1874) and by *Hessler*[9] (1881). I add to *Hessler's* cases those of *Marcé* and *Toulmouche*[10]; collected from older literature, *Moos* and *Steinbrügge*,[11] *Sutphen*,[12] *Politzer*,[13] *Pitt*,[14] have observed each one case, and *May*[15] two cases.

In all these cases the carotid exposed by caries, has not been torn because the osseous support was missing, but because its wall was affected. The carotid does not tear if the wall is sound. *Vohsen*[16] observed, in a consumptive with extensive carious enlargement of the external meatus and tympanum and destruction of the carotid canal, the pulsations of the carotid for weeks without its laceration. The ulceration of the wall of the vessel takes place independently from arterial pressure. It occurs also in thrombotic occlusion of the vascular lumen without pressure in the vessel (*Causit's* case[17]).

From the discovery of tubercular nodules in the adventitia carotidis in tuberculous suppuration of the ear (cf. above), *Pitt's* supposition gains credence. This author supposes, *that tuberculosis may be propagated from the tympanum along the vessels of the pia*. He has observed a case of tuberculous meningitis, which was limited to the fossa Sylvii of one side. Apart from chronic suppuration of the middle ear of the

same side, no older tubercular mass could be found to be held responsible for the infection of the pia mater.

From the intracranial diseases, the development of which by transference of inflammation from the tympanum to the carotid canal can only be supposed, our attention is directed to a cerebral affection which, as it has been proven, may develop in this way. This affection is the cerebral embolism in consequence of thrombosis of the carotid in suppurative otitis media and caries of the temporal bone. We owe this knowledge particularly to the clinician *Gairdner*,[19] the great expert in diseases of the vessels, and to the aurist, *Barr* of Glasgow. A diabetic woman, æt. fifty-four, observed by these authors, suffered from suppuration of the left ear, with peripheric paralysis of the facial. She was seized after severe epistasis, with fever and hemiplegia of the right side, and died twenty-four hours after the appearance of cerebral symptoms in a comatose condition. At the autopsy, a suppuration of the left tympanum, limited to the mucous membrane, was found; furthermore, in the curvature of the carotid, redness of the intima and a præmortal firmly attached thrombus, and finally in the cortex of the left cerebral hemisphere, numerous fresh softenings from embolisms.

Gairdner and *Barr* consider this case as unique, but it does not stand alone as I have found. From the above mentioned case of *Causit*, in which an affection of the aural wall of the carotid had caused thrombosis of the artery, it could be surmised that thrombosis and embolisms might have occurred also in other similar cases. In a case, indeed, observed by *Baizeau*,[20] of fatal hemorrhage of the carotid in caries of the temporal bone, a softening of the cerebral cortex caused by embolism was described, which the author has apparently considered an accidental complication. He describes the condition of the parts as follows: the left middle lobe (the hemorrhage from the carotid took place on the left side) presents at its inner surface a small brown lentil-shaped spot, which penetrated 5 *mm* deep; in its centre a small drop of thick pus is found, which is mixed with softened cerebral substance. At the corresponding

point the arachoroid and the pia mater are sound; there are no false membranes nor adhesions. The external surface of the petrous bone of the cerebral side, or of the side of the base of the skull, does not offer any peculiar conditions.

LITERATURE.

[1] *Rectorzik, Sitzungsber. d. Wien. Akad. d. Wissenschaften*, 1858, 33, 466, quoted from *Urbantschitsch.*

[2] *Koerner*, ARCHIVES OF OTOLOGY (Germ. edit. *Zeitschr. für Ohr.*), vol xxii., p. 189.

[3] *Gruber, Text-book of Otology*, p. 498.

[4] *Barker, Hunterian Lectures on Intracranial Inflammations Starting in the Temporal Bone.* London, 1889.

[5] *Styx*, ARCH. OF OTOLOGY (Germ. edition), vol. xix., p. 244.

[6] *Keller, Monatsschr. f. Ohrenh.*, 1888, No. 6.

[7] *Habermann, Zeitschr. f. Heilkunde*, vol. ix., p. 131, quoted from *Steinbrügge.*

[8] *Marcé, Ulceration of the Internal Carotid in Caries of the Temporal Bone.* Paris, A. Delahaye, 1874.

[9] *Hessler, Archiv. f. Ohrenheilk.*, vol. xviii., p. 1.

[10] *Toulmouche*, quoted from *Marcé.*

[11] *Moos* and *Steinbrügge*, ARCH. OF OTOLOGY (Germ. edition), vol. xiii., p. 145.

[12] *Sutphen*, ARCH. OF OTOLOGY, vol. xv., p. 295.

[13] *Politzer, Arch. f. Ohrenheilk.*, vol. xxv., p. 99.

[14] *Pitt, Guy's Hospital Reports*, tome 47 (1890), p. 332.

[15] *May*, rev. *Monatsschr. f. Ohrenh.*, 1886, p. 199.

[16] *Vohsen, Koerner's* report on the constituting meeting of the German Otological Society, ARCH. OF OTOLOGY (Germ. edition), vol. xxiii.

[17] *Causit, Bull. de la Société Anatomique*, 1886, quoted from *Gidon, Thèse de Paris*, 1877.

[18] *Pitt, Brit. Med. Jour.*, 1890, 1, p. 772.

[19] *Gairdner, Glasgow Medical Journal*, October, 1887.

[20] *Baizeau*, quoted from *Marcé, l. c.*

REMOVAL OF THE STAPES.

By CLARENCE J. BLAKE, M.D., Boston.

(*Continued from page 88 of this volume.*)

THE object of the observations of which this series of papers is a record being to determine the conditions under which the operation of removal of the stapes could be most easily performed, the result obtainable in a series of cases selected in reference to their representation of the types of middle-ear disease to which this operation might be supposed to be applicable, and finally, at the end of a year's observation, the report of the results, so far as obtainable, the next step to be noted is the modification of the first stage, that of incision of the membrana tympani, in reference both to the manner of employing the local anæsthetic, and of making the cut. The strength of the cocaine solution was reduced to five per cent., and then to two per cent., without prejudicing the result so far as the accomplishment of local anæsthesia and the effect in preventing bleeding were concerned; the introduction of the solution through the Eustachian catheter was replaced by simple instillation of a few drops of a two per cent. solution in the nostril on the side of the ear to be operated upon, the head being inclined backward toward the corresponding side and finally this even was abandoned and the cocainization accomplished directly by a preliminary incision in the membrana tympani, as described in an article recently published.[1] It having been found also that the continuance of the cut, from the

[1] Exploratory opening of the tympanum and subsequent operations within the middle ear without general anæsthesia.—*Boston Med. and Surg. Journal*, April 20, 1892.

point just posterior to the short process of the malleus downward towards the posterior border of the manubrium, resulted in a turning of the flap outward in such a manner as to interfere with the accuracy of alignment, the incision procedure was divided into two parts—the first consisting in the opening already described, beginning at the round window and following the periphery to the short process of the malleus, the second beginning posteriorly to and half-way down the length of the manubrium, and being carried upward to meet the termination of the first cut, the intratympanic steps of the operation remaining the same as those previously described.

The following cases illustrate not only the points above mentioned, but others in reference to the removal of the stapes, which will be of interest in the general summing up of all the cases to be made at the conclusion of this paper.

A young woman, twenty years of age, slight, of a nervous temperament, and with a chronic catarrhal inflammation of both middle ears, which had grown slowly worse during the ten previous years notwithstanding local treatment and two years' residence in a southern climate, desired the operation for removal of the stapes in the left ear. Both membranæ tympani were considerably thickened and indrawn, this condition being specially marked in the left, in which the Politzer's acoumeter was heard at a distance of two inches, and the tuning-fork (512 v. s.) aërially $\frac{10}{60}$ths; the voice was heard only when spoken close to the ear in a moderate tone. No cocaine was used in the nose or through the Eustachian catheter, the first step in the operation being an incision about 2 *mm* in length, at the posterior periphery, just above the position of the round window, causing some pain and slight bleeding, both of which were stilled by the application of a two per cent. solution of cocaine on a cotton-tipped probe, the cut being finished almost painlessly under successive applications of the same solution, and showing, when completed, the incus and stapes clearly, though situated well backward.

Disarticulation of the stapes caused no pain but gave the usual scratching sound; the stapes was extracted from above with the usual sensation of suction and temporary change in pulse, but without pain; the tendon of the stapedius, which was left un-

divided, carrying the stapes upward and backward on its release from the oval window.

Following the removal of the stapes there was a distinct flow of fluid, which continued for four days after the operation, gradually decreasing. Two weeks after the operation, the opening in the membrana tympani had entirely healed, the Politzer's acoumeter was heard at a distance of 26 inches, the tuning-fork aërially $\frac{15}{65}$ths by bone-conduction $\frac{20}{65}$ths, and the voice in a moderate tone (heard at the distance of five or six feet immediately after the operation) was heard at the distance of one foot only, and the explodent consonants, T, P, B, and D, were confounded.

The fourth case is of especial interest, as occurring in a man of acute observation, to whom the operation was a matter of interest from a scientific point of view.

The patient was twenty-six years of age, in excellent general health, and had been deaf in the the right ear from childhood, in consequence of a suppurative inflammation of the middle ear, which had resulted not only in the destruction of the membrana tympani, but also in the loss of the two larger ossicles. At the time of the operation the middle ear was perfectly dry, and the mucous membrane of the tympanic cavity, wherever visible, was white and transparent; exploration of the fornix tympani showed that portion of the cavity to be free from obstructions, and the head of the stapes was seen plainly divested not only of its companion ossicles, but also of the stapedius muscle. Tests of the hearing showed the ear to be practically useless, the voice was heard only in a loud tone close to the ear, and neither the medium fork (512 v. s.) nor the large Politzer forks were heard aërially at a distance of one inch from the ear, the larger forks being described as giving only a jarring sensation; by bone-conduction the fork of 512 v. s. was heard in the left, or better-hearing ear, and Galton's whistle was heard only in the lower numbers of its register.

There being no obstacle to the immediate removal of the stapes, and the sensitive portion of the sound-transmitting apparatus having been already destroyed, the use of cocaine was unnecessary. The blunt hook was passed behind the head of the stapes from above, and slight direct traction was made with a view to

testing the fixation of the bone, when, without further effort, and without appreciable resistance or suction sensation, the stapes came away intact, its removal being accompanied by slight vertigo and slowing of the pulse, and followed by immediate improvement of the hearing. Within one minute after the operation a slight blush appeared in the mucous membrane within the niche; this blush rapidly deepened and spread, and at the end of three minutes there was marked congestion of the mucous membrane in and below the niche, and a slight outflow of fluid, presumably perilymph, which outflow was accompanied by an increase of the vertigo. During the succeeding twenty-four hours the outflow of fluid and the accompanying vertigo continued unabated, and then began gradually to decrease this decrease being also accompanied by gradual lessening of the hearing power.

Two weeks after the operation the ear was very nearly dry, and there was no vertigo whatever; the Galton's whistle was heard throughout its whole scale, and the tuning-fork (512 v. s.) was heard aërially $\frac{20}{60}$ths, and by bone-conduction on the mastoid, $\frac{40}{60}$ths but the hearing for the voice was not improved in proportion and was found to be very variable. One week later the ear was perfectly dry, and the improvement in the hearing for the voice was inconsiderable.

In the above case one of the notable points is the evident improvement in hearing by bone-conduction, as the result of the removal of a fixation obstacle which presumably for the time being impaired the intra-labyrinthine sound transmission in accordance with a law governing the propagation of sonorous vibrations in fluid in inclosed spaces, and the occurrence of the vertigo coincidently with the outflow of fluid, presumably labyrinthine, would permit at least the inference that the vertigo was the result of a change in a fixation condition to which the parts had become accustomed, and that the release from supporting pressure consequent upon the outflow of the labyrinthine fluid was accompanied by a congestion in the semi-circular canals giving rise to those symptoms of general vertigo which the patient experienced until the visible congestion in the middle ear had greatly decreased and the outflow had entirely ceased.

Among the symptoms observed by the patient in this case were the alterations in hearing of his own voice.

The right ear had been for a long time virtually useless, and the removal of the obstruction, presented by the stapes and its attachments, to the passage of sound waves and the change in the intra-labyrinthine condition which improved hearing by bone-conduction enabled the patient to hear both aërially and by direct transmission those sounds of his own voice of which he had previously been only monaurally conscious.

It was not therefore the dual sensation in the right ear which had to be considered, but the effect of binaural hearing under conditions essentially different in the two ears.

The result as to general hearing with both ears open was a sense of confusion which was relieved when one or other ear was stopped. If the left ear was first stopped the sense of confusion continued for a longer time than when the right ear was stopped and monaural hearing was practised with the left ear alone, the new phase of hearing brought about by the operative alterations of its condition in the right ear requiring apparently a mental effort of adjustment to the new sensation.

The great changes in the hearing for the voice in the right ear, coincidently apparently with the fluctuations of the flow of fluid from the labyrinth afforded another variable factor in the problem under observation. These alterations in the hearing for the voice were marked more by changes in degree of intensity than in pitch, the change from good to moderate hearing being sometimes sudden and sometimes gradual, within a few hours, all of which symptoms were compatible with the mechanical conditions a vibrating apparatus immersed in fluid no longer invariable in its relationship thereto.

J. G. J., a man fifty years of age, was first seen in December, 1888, with progressive chronic catarrhal trouble of both middle ears. In the left ear there was decided circulatory tinnitus, and the hearing as tested both by the acoumeter and tuning-fork was one half that in the right ear.

Under local treatment the hearing in the left ear improved but subsequently, in consequence of repeated head colds, considerably decreased, so that shortly before the operation the hearing both

for the acoumeter and for the tuning-fork 512 v. s. was inappreciable. In this case three minutes before the operation the catheter was used with two drops of a two per cent. solution of cocaine and the incision on the membrana tympani was completed painlessly with but one application of the solution to the cut edges.

The stapes was high up, and the division of the incudo-stapedial joint was accomplished only with difficulty. Mobilization of the stapes by means of the angular knife and the removal of the bone from the niche, accompanied by the sensation of a loud sound, was followed by the outflow of fluid and by an immediate increase of hearing for low tones, which improvement, however, considerably diminished during the succeeding twenty-four hours.

The operation, including the tests made during its progress, lasted thirty minutes, and was without pain to the patient, who described with precision the noises incident to that part of the operation within the middle ear.

One week after the operation the wound in the membrana tympani had entirely healed, and the hearing both aërially and by bone conduction was the same as before the operation.

Mrs. A. R., fifty-six years of age, was first seen two weeks before operation ; the patient was slender, not very strong, and had a history of repeated head colds and a gradual decrease of hearing in both ears.

Both membranæ tympani were slightly opaque and indrawn ; both Eustachian tubes were free ; the hearing distance for the Politzer's acoumeter was, in the right ear, three inches, and in the left ear one half inch ; the tuning-fork 512 v. s. was heard in the right ear $\frac{2}{6}\frac{5}{5}$ths in the left ear $\frac{1}{6}\frac{5}{5}$ths, and by bone-conduction on the mastoid process in the right ear $\frac{2}{6}\frac{0}{5}$ths, and in the left ear $\frac{2}{6}\frac{5}{5}$ths.

Shortly before the operation a few drops of a two per cent. solution of cocaine were injected through the Eustachian catheter. The preliminary cut in the membrana tympani caused pain, which was stilled by means of a ten per cent. solution of cocaine, and the cut was then continued painlessly ; all that part of the operation within the middle ear was also painless unless the shaft of the instruments touched the cut edge of the membrana tympani. The incudo-stapedial articulation was high up and far backward, and the division of the stapedius tendon, apparently complete, was probably in fact only partial, as after division of the articulation the attempt at removal of the stapes, resulting in the fracture of

the crura coincidently with the lifting of the base plate, was immediately followed by the disappearance of the fractured crura and head of the stapes upward and backward.

Up to this point in the operation, which the patient had borne well, there was no symptom other than that of fatigue, but with the fracture and partial removal of the stapes there was vertigo, general depression, temporary unconsciousness, and a change in the pulse, which became small and rapid—112.

These symptoms, together with nausea, continued without abatement for nearly an hour, at the end of which time the patient could keep her eyes open without vertiginous sensations, and dizziness was evoked only on rotating the head slightly upon the pillow. This vertigo slowly decreased during the succeeding three days, but had not entirely ceased until nearly two weeks later.

Tests of the hearing made during the operation showed a slight improvement in the hearing on completion of the incision in the membrana tympani and this improvement markedly increased during the succeeding steps of the operation.

Eighteen days after the operation, the opening in the membrana tympani having healed, the Politzer's acoumeter was heard at the same distance as before operation, and the same tuning-fork used in previous tests was heard aërially $\frac{20}{60}$ths, and the voice in a loud tone was understood at a distance of three feet.

In both of the preceding cases a point with reference to the voice tests which had been observed in other cases was worthy of note: in both of them the voice was heard apparently much better immediately after the operation than before, but an analysis of this apparent improvement showed that it related rather to volume and intensity than to an improvement in that differential perception of sound values which constitutes our means of distinguishing the relationship of the consonant sounds.

In both instances, the voice, used as nearly as possible with the same force and making use of the same test sentences as before operation, was described as being louder but not as more distinctly heard; and in one case the patient described the sensation in hearing the voice as so altered from the standard to which he had become accustomed in using the other ear as to give him a very definite sense of confusion.

A CASE OF OTITIS MEDIA ACUTA PURULENTA WITH CARIES OF THE MASTOID PROCESS DUE TO CARIES OF THE SECOND MOLAR TOOTH.

By DR. E. SCHWARTZ, of Gleiwitz, Silesia.

Translated by Dr. Max Toeplitz, New York.

Hugo J., age twenty-one, of Grünberg, presented himself on September 12, '91, at my office with violent pain in the left ear, lasting two weeks, and otorrhœa of a week's duration with subsidence of the pain.

The external auditory meatus was found to be filled with thin secretions and its osseous portion to be reddened after their removal. Its *antero-inferior* wall close to the membrana tympani was so much thickened as to leave, posteriorly and above, a fissure of nearly a millimetre in width, through which the corresponding segment of the membrane could not be seen distinctly. This hemispherical thickening, when probed proved to be of bony consistence, giving a distinct impression of exostosis with infiltrated periosteum. This supposed exostosis gave so much the less uneasiness, as aërial douche with catheter produced loud perforation noise and considerable subjective relief, so as apparently not to disturb the permeability. The catheter was readily introduced, although after every introduction slight bleeding occurred from the nose, which on inspection revealed that the dark-red mucous membrane of the nasal floor was swollen and loosened. The decrease of secretions from the tympanum, the constant improvement of the patient together with the cessation of hemorrhage, drew my attention away from this phenomenon and led me to suspect spontaneous improvement of the affected nasal mucous membrane.

On Sept. 21st (ninth day of treatment), in introducing the

catheter, increased swelling of mucous membrane of the floor of the left nostril was felt, and a few drops of blood oozed from it so as to direct my attention to this fact and lead me to the supposition of its local cause in the superior maxilla. A carious root of the second molar tooth was thus found in the left alveolar process of the superior maxilla, and about 1½ *cm* above in the hard palate a fistulous opening, through which the probe penetrated 1 *cm* deep in the direction toward the tip of the carious root. The patient, when questioned, now stated that he suffered for more than five years from sensitiveness of the palate until the present time, but without great inconvenience. Three days subsequently to the immediate extraction of the root the fistulous opening could hardly be detected in the palate, and after two further days was completely closed. At the same time the mucous membrane of the nose assumed its normal condition, whilst the hemorrhages did not take place after introduction of the catheter.

On Sept. 25th (thirteenth day of treatment) the *posterior* wall of the external meatus appeared thickened and was immediately incised in the entire length of the osseous portion. The patient felt relieved, according to his statement, on the following day. On Sept. 27th he complained of extreme weakness and headache in the left side; the processus mastoideus was sensitive upon pressure, just as the previous day. The thickening of the posterior wall of the external meatus is progressing upward. In the evening, chills and febrile delirium, with a temperature of 40° C. ensued. On Sept. 28th at noon, chiselling of the mastoid process was performed after an additional thickening of the *upper* wall of the external meatus had been found upon examination. The physicians *Struwe*, *Neumann*, and *Kreisel* kindly assisted at the operation.

An incision, 1 *cm* from the insertion of the auricle, parallel with the latter, was made into the normal tissue over the left mastoid, and the moderately thickened periosteum is readily ablated and placed to either side; slight hemorrhage occurs. The osseous surface presents a moderately grayish discoloration. After marking the upper operative boundary line at the planum mastoideum at a level with the spina supra meatum by a stroke of the chisel, the opening with the chisel is started from this spot. After the removal of three small osseous splinters a drop of yellow pus oozes out. A few granulation pearls are removed with the

sharp spoon ; the underlying osseous tissue proved to be healthy, so as to render a deep operation unnecessary. During cleansing with the cotton pellet, suddenly a small drop of pus oozes from the *upper* margin of the opening, immediately below the cortical layer of less than 3 *mm* in thickness ; this is followed by the chisel and the osseous opening extended farther upward at $\frac{1}{2}$ *cm*. A few granulations are removed with the sharp spoon from this extended opening, below which healthy osseous tissue is found. A third drop of pus oozes, but now from the posterior margin of the enlarged opening, immediately below the osseous surface, and granulations are also found. This flow of additional pus is from 4 to 5 times repeated, and the operative surface made to follow the pus is band-like and approximately 1 *cm* wide, of the shape of a horse-shoe with the concavity toward the auricle. In the outer limit of the posterior portion of the operated region an osseous cell of about $\frac{1}{2}$ *cm* in diameter filled with pus and granulations was opened. A drainage tube was placed into this cavity, the other end reaching the anterior portion of the operative field. The edges of the wound were united by three stitches.

At 6 P.M., 38.7° C.; at 8 P.M., 38.5° C.

On September 29th, in the morning, 37.7° C.

On September 29th, in the evening, 37.6° C.

The patient feels very well ; extreme perspiration, no headache ; tongue coated. During the entire period of convalescence the temperature did not rise above 37.3° C.

A week subsequently to the operation, the cleft of the external meatus, through which the posterior-upper segment of the membrana tympani was visible, became wider, which was due to the decrease of infiltration of the posterior upper wall of the meatus, but the cleft gradually increased every week, until in the beginning of November the entire posterior upper third of the membrana tympani appeared. I still explained this phenomenon by the decrease of the swelling of the periosteum belonging to the exostosis. In the course of the further out-door treatment the perforation of the membrana tympani was closed, the noise during the aërial inflation became broader and blowing. In the middle of November the handle of the malleus presented itself in the tissue of the membrana tympani of pale-pinkish color. Whispered voice was well perceived with the left ear turned away, up to a distance of 5 metres, and at the end of December the supposed exostosis had entirely disappeared. The normal drum

membrane presented itself in its entire extent. On December 23d Mr. J. was discharged from my treatment as completely cured.

REMARKS.

I am convinced that the entire affection had originated from the carious root of the second molar in the left superior maxilla. The caries was transmitted to the upper jaw; whence the fistula occurred in the hard palate, which was readily closed after the removal of the dental root at fault. Thence the virus had affected the periosteum and simultaneously the mucous membrane upon the left nasal floor, consequently its redness, swelling, and slight hemorrhage during introduction of catheter, which ceased immediately and completely after the removal of the dental root. The periostitis had extended from this region through the Eustachian tube into the tympanum and also into the osseous portion of the external meatus, where it first reached the *inner-lower* portion, corresponding with tympanic opening of the Eustachian tube, and formed a circumscribed and hemispherical infiltration,which I had considered erroneously up to the final time of my observation as a genuine exostosis. (cp. *Politzer, Text-book of Otology*, German edition, 1882, p. 703: "The causes of development of exostoses are . . . 2, circumscribed, chronic periostitic inflammations in the osseous external meatus.")

The periostitis, which was *secondary* upon the superior maxilla, but *primary* in the tympanum and mastoid process, had progressed to this region, when Mr. J. came under my observation. I have observed and described above the way in which the periostitis had implicated the posterior and also the upper wall of the external auditory meatus. When on September 25th the posterior wall of the external meatus was found to be thickened, the periosteum lining the external surface of the mastoid process also had then positively been implicated in the inflammation, a phenomenon which could not objectively be observed, nor cause well localized objective symptoms. The period from September 25th to 28th, viz., four days, sufficed, in order to necrose the exter-

nal osseous layer to a depth of about ¾ *cm.* Chiselling was done in time so as to prevent more extensive caries of the spongy layer.

It is quite important for the correctness of my view that the periostitis, in advancing from the antero-inferior wall of the external meatus to the external surface of the mastoid process, first implicated the *posterior* and on the day prior to the operation also the *upper*, wall of the meatus. *Schwartze* describes as an important symptom of caries of the mastoid, the infiltration of the *postero-superior* wall of the meatus in its osseous portion, and with this symptom I could invariably confirm the diagnosis of caries by the operation, particularly in some cases of chronic suppuration of the tympanum, in which (characteristic subjective symptoms excepted) nothing abnormal could be objectively found in the mastoid process. In all these cases the above-mentioned periosteal thickening was *the consequence* of caries of the mastoid of long standing, whilst in our case, as it appears from the operation, the central portion of the mastoid process exhibited normal relations.

Whilst the caries usually takes an outward course from the tympanum through the mastoid antrum, the centre of the mastoid process, in this case, the caries, if I may use the term in its widest sense, has proceeded through the tympanum and the external meatus to the external surface of the mastoid process, in order to penetrate the external wall centripetally. With reference to the mastoid process, the periostitis of the external surface was *primary*, the caries *secondary*.

If my view is correct according to my statements, my case demonstrates that the condition of the teeth should not be overlooked either in *nasal* affections, as *Ziem* and others have repeatedly and urgently pointed out, or in carious and non-carious *aural* affections.

THE ANATOMICAL CONDITION FOUND IN A CASE OF DEAF-MUTISM FOLLOWING SCARLATINA.

By DR. V. UCHERMANN, Christiania.

Translated by Dr. S. E. Allen, Cincinnati, O.

THE following case of acquired deaf-mutism was examined by me, in the Pathological Institute here, as long ago as 1883. The publication of the case has been deferred until now on account of deficient information as to its etiology, which has only lately become clear.

I had also hoped to be able to submit the results of other anatomical examinations on deaf-mutes, but circumstances have not been favorable. I hope, however, in the future, when the schools for deaf-mutes become public or come under public inspection, to more easily obtain material for examination. In the meantime I do not want to hold back my case any longer.

Johann Arnesen Nor, Brandvold, eighteen years old, died in 1883.

Post-mortem Record.—Tuberculosis pulmonum. Cavernæ tuberculosæ et bronchiectasia, ulcera tuberculosa ilei et cœci.

At the age of two and one half years contracted scarlatina, as a consequence of which deaf-mutism.

Examination.—Right ear. External meatus and tympanic membrane normal, likewise the mucous membrane of the tympanic cavity and the ossicles. Stapes immovable (ossified annular ligament). Membrana rotunda forms bony plate. Malleus and incus movable. Tensor tympani well developed. Of the semi-

circular canals there is present but a slight indication in the form of a canal one half of a centimetre long, filled with fibrous connective tissue and corresponding to the canalis semicircularis superior. The vestibule forms a small cavity lined with thick periosteum. No indication of the sacculus. Forward and slightly outward from the ossified fenestra rotunda, one sees a small, irregular, undivided canal one and one half centimetres long. Otherwise there is no trace of the cochlea, except a yellow, somewhat porous circle in the bone indicating its position. The acoustic nerve, of normal appearance and size, divides at the bottom of the meatus auditorius internus into two branches which penetrate into the bone.

Left Ear.—External auditory canal filled with pus. Five perforations in the thickened membrana tympani. Tympanic cavity filled with muco-pus and crumbling masses, as are also the remaining cavities in the temporal bone. The ossicles movable. Tensor tympani somewhat atrophic. Membrana rotunda ossified. Labyrinth and acoustic nerve appear normal. In the cochlea and internal meatus no pus.

The brain was examined in December, 1890, by Prof. G. Güldborg, who kindly communicates to me the following:

Abstract.—"A deaf-mute's brain hardened in Müller's fluid, shows upon its surface, as far as can be judged from a hardened specimen, on the whole, normal conditions. The central gyri are well developed. The occipital fissure extends in deeply on the convexity. Broca's convolution seems to me to be narrower than normal. The upper temporal gyrus on the left side appears also somewhat narrower than usual. The microscopical examination shows nothing positively abnormal.

The case presents various points of interest. It is the first specimen of deaf-mutism due to scarlatina. Of the one hundred and twenty-six post-mortem appearances observed in cases of deaf-mutism, published up to date, thirty-two concern hereditary and thirty acquired deafness, while of the origin of sixty-four nothing is said. It is clear that an essential part of the interest in these post-mortem examinations is lost if we do not know by what diseases the changes pointed out have been produced, or even whether the deafness was hereditary or acquired. The clinical history of these cases is all the more necessary as a certain conclu-

sion concerning the character of the primary disease can often not be formed from the anatomical appearances. For example, inflammation in the labyrinth can bring about such a complete sclerosis of the pars petrosa, together with osseous changes in the membranous parts, that almost no trace of the semicircular canals, cochlea, or spongy tissue can be discovered. One finds only a smooth mass, hard as ivory, with normal external contours, so that at first one is most inclined to consider the condition hereditary. Mygind (Denmark), in *Archiv für Ohrenheilkunde*, Bd. xxx., in summarizing the results of anatomical examinations of the organ of hearing in deaf-mutism, lays great stress upon this fact.

The case is still further remarkable in that the disease in the right ear appears to have been limited exclusively to the labyrinth, the membrane and tympanic cavity not showing the slightest sign of previous inflammation. The ossification of the annular ligament and of the membrana fenestræ rotundæ appears to have developed from the labyrinth side, as the tympanic side showed no trace of osseous or fibrous new formations. In the left ear, on the contrary, the middle ear, with the spongy part of the pars petrosa and the processus mastoideus, was diseased; here also was ossification of the membrane of the round window, while the annular ligament was found movable. Moreover, since the semicircular canals, vestibule, and cochlea were found to be normal, with no trace of pathological fluid or new formations, it is to be accepted that the ossification here started from the tympanic cavity. In this ear probably a slight amount of hearing existed, but not enough to obviate the deaf-and-dumb condition. Unfortunately, concerning this, no examinations were made, which would have been of the greatest interest with reference to the question as to what influence a rigid membrana fenestræ rotundæ would have upon the hearing of an otherwise intact inner ear.

Thirdly, the case contributes to the pathology of middle-ear complications in scarlatina. The most widespread acceptation undoubtedly is that the inflammation extends from the pharynx to the middle ear and then causes a secondary labyrinth inflammation with deafness. In a class of

cases the view that the pus breaks through the membrana rotunda or the carious labyrinth wall is undoubtedly correct, or that the suppurative process causes an osseous or fibrous new formation in and around the windows. There are, however, other cases where the deafness arises acutely during the disease without the middle ear being especially or at all affected. In such cases we find the drum normal or but slightly dulled, the hammer being perfectly movable (Delstanche), the Rinné experiment is positive, there is absence of bone-conduction, and often total deafness. As Moos has demonstrated in measles and diphtheria and also in scarlatina, there takes place here undoubtedly a penetration of bacteria into the labyrinth, either directly by the blood or lymph channels, or indirectly from the subarachnoid space through the aquæductus cochleæ. Again from the subdural space, which, according to Key and Retzius, is in communication with the nose and lymph vessels of the nose, can the infection, attacking the saccus endolymphaticus, extend through the aquæductus vestibuli into the endolymphatic channels of the inner ear. Here, according to Moos, the bacteria cause a coagulation of the endo- and perilymph, together with stasis, thrombosis, and vessel necrosis.

Moreover we find, especially in scarlatina, as my case plainly shows, an infiltration of the Haversian canals and hollow spaces, together with an hypertrophy of the periosteum and subsequent ossification of the newly formed tissue. A case published by Mygind (*Hospitalstidende*, 1890) shows that the same changes occur also in measles. After meningitis cerebro-spinalis such a change is not unusual. It is altogether probable that all mycotic diseases can give rise in a similar way to labyrinth affections and deafness. As a matter of fact, in my examinations here in the country, I have found single instances of such cases following varicella, rubeola, pneumonia, and pertussis. Probably a case which occurred after an acute eczema may be explained in the same way. The changes in the brain, reduction in size of the third left frontal gyrus (Broca's convolution), and of the upper left temporal gyrus, agree with the other appearances in that the dumbness could have brought about an atrophy of these

convolutions due to the diminished functional activity. The complete destruction of the labyrinth on the right side could have produced the same condition of the temporal gyrus of the left side. According to the researches of Munk, there is reason to believe that there takes place a crossing of the fibres of the acusticus in the brain.

ON THE CLINICAL SIGNS OF THE AFFECTIONS OF THE AUDITORY NERVE.

By Prof. G. GRADENIGO, Turin, Italy.

Translated by Dr. S. E. Allen, Cincinnati, O.

I HAVE had the opportunity of studying a few, in my opinion, not uninteresting cases of deafness attributable to lesions of the acoustic nerve. In one of these, which had to do with a cholesteatomatous tumor on the left nerve, I was able to demonstrate by anatomical examination the integrity of the labyrinth. The clinical characteristics with which I met in the largest proportion of acusticus affections, and which can serve as diagnostic criteria in doubtful cases, were the following.

I. Diminution of the acuteness of hearing, and that too demonstrated by examination with tuning-forks, and more markedly by examination with forks of middle register. This diminution was associated with the other clinical symptoms which in general are proper to affections of the perceptive apparatus. As a differential diagnostic criterion, one observes, in affections of the nerve, that the acuteness of hearing for high tones, which diminishes the earliest in changes of the labyrinth, is here well maintained.

The functional defect for middle tones increases in some cases to a complete disappearance of perception for some of these tones (for example c^1). This can be made out only by tuning-fork examination and not usually by means of other musical instruments which possess overtones (violin, horn, organ pipe, etc.). In two cases in which a diagnosis of a lesion of the acusticus could have otherwise been made,

as there was present double-sided deafness with various cerebral symptoms, the character of the functional defect, which was especially marked for high tones, justified the diagnosis of inflammation of the labyrinth, and this diagnosis was confirmed by the statements of the patient and the clinical course of the disease. In keeping with the relatively good preservation of perception for high tones, the watch and in some cases my osteo-tympanal *audimeter* which produces weaker tones than the watch, could be perceived by osteo-tympanal conduction.

These results confirm those I stated three years ago, based upon the examination of two cases of nerve disease.

II. Another important clinical characteristic with which I have met in some affections of the acusticus, consists in an excessive functional exhaustibility. According to my experience, this symptom may be met with, although very seldom, in middle-ear affections, especially in neurasthenic individuals. This exhaustibility is also often produced by alterations in the inner ear, but only in affections of the auditory nerve does it reach a sufficiently marked degree to be characteristic. The functional exhaustibility is often so considerable that the results of the examinations by the different methods became so essentially modified that it is impossible, if no account is taken of this fact, to form an accurate conclusion as to the amount of hearing power present.

The methods of studying the functional exhaustibility of the acusticus are different. Better than the other methods of examination, among which stress is to be laid on that advocated by Eitelberg, is the examination by means of an instrument modelled on a telephonic *audimeter*. With this I have been able to accomplish the end in view very satisfactorily. I proceed in a twofold manner: first, I determine the least intensity of tone that can be perceived, then I expose the ear a minute or so to the greatest intensity of the same tone which I can obtain from the instrument. I then reduce the tone quickly to the minimum intensity heard in the beginning. While now a normal ear, in spite of the quick reduction in intensity, still perceives the tone,

in cases of great exhaustibility this perception either ceases for several seconds or is entirely lost.

By means of the other method of examination I am able to follow up more exactly the gradual decrease in the functional energy. After establishing the minimum intensity that can be perceived, I expose the ear to the action of that tone. If the functional exhaustibility is considerable, the patient after a few seconds ceases to perceive the same. In order to renew the perception, it is necessary that the intensity of the tone be progressively increased from time to time. In some isolated cases, I was able to recognize that the functional exhaustibility preceded a temporary increase of the power of hearing.

Up to the present time, I have not had at my disposal sufficient clinical material to be able to assert that the above-mentioned characteristics of affections of the auditory nerve occur in all cases. It is probable that the different pathological changes in the acoustic nerve would present various points of difference on examination. I found this symptom of exhaustibility in cases of neuritis (caused by trauma, compression) and also in cases of secondary or primary atrophy occurring in tabes dorsalis. I should like to add that the acoustic nerve comparatively seldom participates in the various intracranial pathological changes, and that certain forms of deafness which occur in neuropathic individuals, and which therefore, at the first glance, seem to be dependent upon intracranial disease, will be found on thorough examination to be due to some unimportant alterations in the inner or middle ear. I do not desire here to enlarge upon hysterical anæsthesia of the acoustic nerve. This exhibits special symptoms, among which stress is to be laid upon the absence of attacks of dizziness and upon the uniform distribution of the defects in the musical scale.

In cases of beginning neuritis of intracranial origin, in which as yet no important functional alterations have ensued, the electrical test can be of great value, as by it the excessive irritability of the nerve can be demonstrated.

SOME FURTHER INVESTIGATIONS UPON THE CONTINUOUS TONE-SERIES, ESPECIALLY WITH REFERENCE TO THE PHYSIOLOGICAL UPPER AND LOWER TONE-LIMIT.

By Prof. F. BEZOLD, Munich.

Translated [1] by Dr. E. B. Dench, New York.

(*With two Illustrations.*)

IF in the following I present to-day some observations upon the use of an unbroken series of tones for testing the hearing, as introduced by me two and one half years since, the reader must expect nothing absolutely conclusive. In the first place, the time is too short to settle with a sufficient number of clinical cases the most important query which this promises to enable us to determine, namely, the occurrence of such tone defects as we must relegate to middle-ear affections. These have seemed to me to be more common than we would judge from a consideration of the cases reported in literature; they are found invariably only in a small proportion of the affections of the internal ear, and these, moreover, constitute but a small part of aural affections. Again, in the further pursuit of the investigations, the necessity presented of amplifying the tuning-fork series, at least in the lower portion of the scale, since this would determine the physiological variations met with here.

Upon the presentation of my continuous tone-series at the Nuremberg Society of South German and Swiss Otologists in 1890, and at the Otological Section of the Tenth International Medical Congress at Berlin, certain objections were raised against their employment.

[1] Two tables omitted.

According to Lucae and Schwabach, both the low and high notes, if of great intensity, would affect the ear. In the exhaustive method of investigation advised by me, we need use only a sufficient intensity in the various tones of the series to be just perceived with certainty by the affected ear. By the use of the loud high-pitched fork, long ago advised by Lucae, no investigator has ever deviated from the beaten path.

A second objection, made first by Politzer, and later by Lucae, Gradenigo, and Barth, is based upon the admitted unreliability of the test with a single form of instrument for producing a given note. It may happen that the same tone which, if produced by vibrating tuning-forks, is not heard by the diseased ear, may be perceived if emitted from organ pipes, flutes, horns, trumpets, sirens, etc. Flutes, trumpets, and sirens are instruments not at all free from overtones. They cannot be considered here. The only instruments relatively free from overtones which we can compare here, are, according to Helmholtz, tuning-forks and wide covered organ pipes. We have no means of comparing exactly the intensity of the tone produced by both instruments, and our subjective judgment cannot be accurate. It is quite possible that in a given case a tone produced by a tuning-fork may not be heard, while the same note from an organ pipe may be perceived. By this nothing more is proven than that the perception of this note is greatly lessened, but not completely absent; that, in other words, there is a relative but not absolute tone-gap. Frequently enough I have had the opportunity to demonstrate absence of perception for the same tone, produced upon these two different testing instruments, and then we are justified in assuming an absolute tone-gap for the given note of the scale, so far, indeed, as the intensity of the pure tones employed permits us to determine such a condition. An instance in which the weaker tone of the one instrument has been heard, while a stronger and equally high tone produced by the other has not been perceived, has never happened to me at least.

When in Nuremberg two and a half years ago, I advocated

the use of the continuous tone-series for the first time. Politzer believed that, if only the clinics would use the full series, perhaps further investigations would show that the practitioner could get along with a few less forks. At present, the complete series is in the hands of but few investigators. A single manufacturer made all the instruments according to my directions, and under my personal control. Since I naturally could not continue the same supervision, in the instruments made subsequently, it appears clear that, in addition to the high price, the fact that the successive instruments are not entirely identical, explains an important impediment to their application.

For my part, the necessity of this series of instruments has become of so much importance in the hands of the otologists, that I believe we shall yet live to the time when one can as little think of the otologist without them, as of the ophthalmologist without the perimeter.

The incompleteness of the tone-series made itself felt very soon, at the lower end of the scale, in the course of diagnostic tests. I had carried it to the contra C (32 double vibrations) by means of a heavily clamped tuning-fork. This tone is, however, an octave removed from that which Preyer fixes as our physiological lower tone-limit.

The fork C^1, as a rule, suffices for the determination of the lower tone-limit in pathological conditions of the middle ear, since this tone in chronic affections without an exception, and in acute cases for the most part, falls without the hearing limit. A great number of cases in which the hearing is markedly impaired, are found among diseases of the internal ear, which hear this tone very well, so that, for a complete examination of these patients, a lower tuning-fork appears to be an absolute necessity.

I applied for this to Appunn in Hanau, who had made Preyer his instruments, for the determination of the tone-limit, and received a fork which furnished at least partially the desired octave. Through the co-operation of our physiologist Van Voit, it was possible for me to test this, and to register the number of vibrations. It was found that, by moving the heavy clamps, a series of tones could be pro-

duced from 19½ to 34 double vibrations per second. It did not reach, however, as far as the lower limit determined by Preyer, of 16 double vibrations. Consequently I had made for me, by Appunn, a second tuning-fork, similar to the above, and provided with clamps, with the exception that both branches were 6 *cm* longer, the movable weights being the same.

Being possessed of this, for a long time all patients whose lower tone-limit was within the range of these two forks, were tested with both instruments. It was shown that, in the cases where defects were present in the lower part of the scale, the weights must be fixed at almost the same distance from the forked end of the branches, in both cases, in order that the tone should be just perceived. The lengthening of the slender branches of the fork, as compared with the loading with heavy weights, need scarcely be considered. Therefore, through this lengthening, a further portion of the lower part of the tone scale was gained. In the last year we have determined the rate of vibration of this long tuning-fork, at the Physiological Institute in Munich, by recording vibrations of this upon a revolving cylinder, while an electric chronometer indicated upon the vibration curve the second intervals. The tuning-fork in these experiments, provided with a marking point, was held in the hand close to the cylinder, the same as in examining the ear.

The record of this longer tuning-fork showed that, by the aid of both clamps, and by moving them, the whole tone-series could be produced at the lower portion of the scale, which to this time had been wanting; that is, the tones from 16 to 30 double vibrations. An over-tone is produced at thirty vibrations, but this is easily eliminated by touching the branches at the lower end. The tones become weaker and weaker in descending the scale, but the greater number of those examined by me perceived, even for sixteen vibrations, a deep low tone, if the examination was made in a perfectly quiet place. The individual vibrations were distinctly perceived by the eye as well as the ear. A smaller number, whose hearing was otherwise normal, perceived absolutely nothing during the strongest vibration

of this fork, at this low point, and for a portion of the scale above it. The last observation appears certain, since no extraneous noises were present.

The determination of the lower as well as the upper tone-limit, in a greater number of persons with normal hearing, as of any determination of the normal condition, which is capable of exact measurement, demands an attention which far exceeds our present otological attainments. Aside from the twenty-three pupils with normal hearing, whose functional examination Siebenmann has undertaken, and published in this journal, no more extensive series of investigations, with references to individual conditions, has been made up to the present time.

The upper tone-limit was measured by Siebenmann, by means of the Galton whistle; it lay, according to the instrument which he used, between 1.3 and 1.9. The tuning-fork employed for the lower tone-limit (C — 1, thirty-two double vibrations) lies so far removed from the true limit, that we ought not to wonder that it was perceived by all the cases tested.

The significance of age, in relation to the extent of the normal hearing limits, has of late been brought forward by Zwardemaker (*Archiv für Ohrenheilk.*, vol. xxxii., p. 53), who gives a graphic representation, in the form of a curve, of the narrowing of the limits of hearing with advancing age. In a great number of individuals of different ages, which are not specifically given with normal hearing, Zwardemaker determined the upper tone-limit by means of the Galton whistle, as Siebenmann did, and found it to be 1.25 in childhood; with the advance of years it continually became lower, to from 2.5 to 4.0 in old age.

He sees here a condition, which is clearly developed by systematic investigation. Pathological processes in the middle ear exert so little influence upon the progress of lowering the tone-limit of sound perception, that it is easy in a great assembly to arrange the individuals tested, according to their age, from the results obtained with the Galton whistle. He tested the lower tone-limit on only a few individuals with the Appunn metal plate, but believed that,

with more advanced age, progressive narrowing could be determined here.

After these investigations, it appears necessary, before we undertake a classification of the perception of the tone series in diseased ears, to determine the upper and lower tone-limits, not only absolutely, but also relatively, as met with at different periods of life.

Since I have had the low tuning-fork of 16–30 vibrations, I have tested a number of normal ears (190) for the upper and lower tone-limits. As the period of advanced life must be taken into consideration in this investigation, for this reason, the limit of normal hearing power in general, as evidenced by the test with the whisper, must not be placed too high, and every case was designated as normal, which, in addition to other numbers, was able to understand, under proper precautions, the whispered number "100." The upper tone-limit was also determined by me, with the Galton whistle.

If we consider the summary, the absolute upper tone-limit upon the Galton whistle used by me was found to be 1.5 of the scale; only two cases reached the limit. In thirteen cases the limit was 1.6; in thirty-three, 1.7; between 1.7 and 2.2 in 105 cases; between 2.2 and 3 in thirty-four, and from 3. to 3.6 in three cases only.

From this series of figures, we can plot a curve, with a distinct culmination point, at 1.7 with a precipitate and constant descent at the upper part, and a slower and not quite regular descent to the lower limit. This last will become more uniform, as the number of cases tested becomes greater.

In the following figure I have made a graphic presentation of the results obtained, both by Siebenmann and myself, in testing with the Galton whistle. The successive tenths of the scale of the whistle are laid out upon the abscissa line, while the number of cases, whose upper tone-limit corresponds to any of the given divisions of the scale, is laid out upon the ordinate.

Both from the form of each of these curves, with their varying point of culmination, as also from their remarkably close agreement with each other (in analyzing the curves we

must remember that Siebenmann has examined young people alone, while my investigations embrace individuals of all ages), we are justified in drawing the conclusion that the test with the Galton whistle gives a greater danger of error than was formerly appreciated by myself and many others, on account of the confusion arising from the blowing noise.

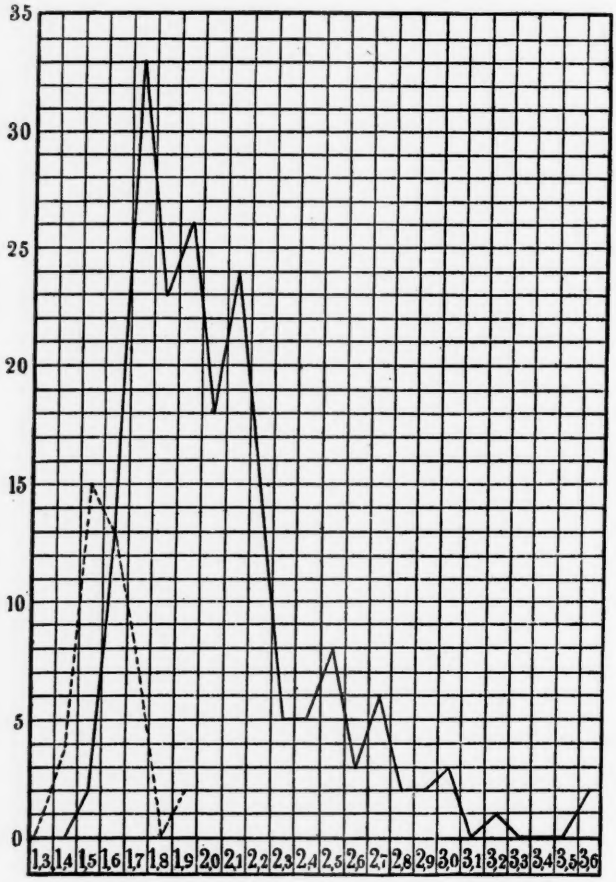


FIG. 1.

The accuracy of the audition of those tested, should consequently be confirmed. When the limit is neared, we successively make the note of the whistle lower; if the subject signifies that in response to this the whistle is heard more distinctly, then the limit has been passed by. A second means of control is to interpose each time, between the

uppermost notes of the whistle, a pure blowing sound, by screwing the instrument up for a greater distance. It is always advantageous to confirm the result several times.

The influence of age upon the upper tone-limit is shown in the table, which gives the successive height of the tone-limit in divisions of the scale of the Galton whistle, in the various years of life, from ten to twenty years, up to sixty or more years. The hiatus at the upper portion of the scale, which takes place usually in advancing years, is quite per-

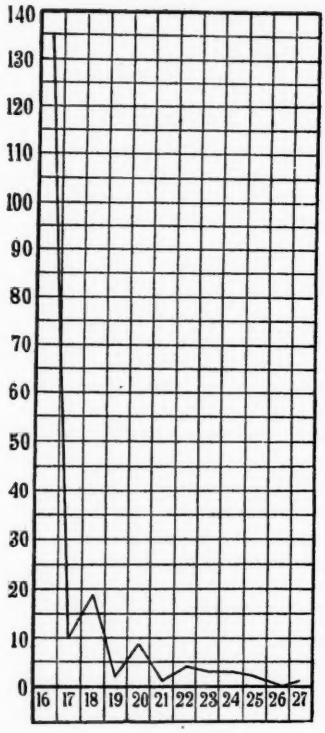


FIG. 2.

ceptible, but by no means as marked as it appears from the investigations of Zwardemaker. Until the very late period of life, not in a single instance was a half division of the twelve parts of the Galton scale lost, through the advancing period of middle age. Also the lowering of the upper tone-limit was found not to be regularly progressive; individuals from twenty to thirty years and from fifty to sixty years of age were found to hear higher notes than those of the preceding decade.

If we turn now to the record of the individual statistics of the lower tone-limit in the different years of age, and the changes therein, it must be certain, above everything else, that the tuning-fork employed is free from any accompanying sounds, and devoid of overtones. If we cover the eyes of the patient, and cause him to tell us in every case when sound was first perceived, errors in this test are excluded. Consequently the results portrayed in the curve shown in Fig. 2, drawn from the statistics secured in the above manner, present much more forcibly than we have found to be the case in the curve representing the upper tone-limit.

Had this curve been drawn with an equally large number of subdivisions, the highest point would lie five times as high as in the figure. The descent upon one side is very abrupt, gradually becoming lost, with moderate variations, in the zero line. These variations also would probably no longer have existed, in spite of the only moderately large number of individuals examined, had it not been that in most cases only the vibrations represented by even numbers were recorded, since these alone were marked upon the fork, as irregularities are present in the curve for vibrations represented by odd numbers only.

The lowest row of figures, which gives the successive lower tone-limit found at different periods of life, in double vibrations of the Appunn tuning-fork, shows, as in the case of the upper limit, an increasing narrowing with advancing years. It is, however, neither pronounced nor uniformly progressive. From 10 to 50 years, the loss at the lower end of the scale amounts to scarcely half a vibration (.48); from 50 to 60 or older, it amounts to 2.72 vibrations. If we reflect upon the changes and diseases which influence the ears until advanced life is reached, these alone would serve to explain the small defects found both at the upper and lower end of the scale, and we need not accept of necessity a senile degeneration. Indeed, they are not at all comparable with the impairment of vision in old age, which, according to the investigations of De Haan, sinks almost one half from 10 years to 80 years of age.

A distinct narrowing of our scale of hearing, both at the

upper and lower portions, exists in only a very slight degree as the result of age alone, and not distinctly attributable to other causes.

Quite different is the state of the acuteness of audition for our entire hearing power, of which we obtain the most complete evidence through the test with speech. That the power of perception for this undergoes a distinct loss in advanced life, as Haan has found for the sight, will be brought out by a further series of experiments, the labor of which busies me now.

As an average upper tone-limit for the Galton whistle, the investigations of 190 cases of all ages has given this as 2.03 (for males, 2.02; for females, 2.05) upon the scale of the instrument. The average lower tone-limit was reached at 17.04 double vibrations per second (for males, 17.16; for females, 16.90). Hence they differ from distinctly pathological cases, whose lower limit lies at 43 double vibrations. Males were of somewhat more acute hearing for the highest portions of the scale, while females were of more acute hearing for the lowest portion than the other sex; it is entirely possible, however, that these insignificant differences will disappear in a more complete series of experiments.

A fact of greater importance is presented, however, by the limited series of experiments recorded here. If we compare the curve found for the upper tone-limit, as determined by either Siebenmann or myself, with the curve of the lower tone-limit, the two first show us that our limit of audition, at least for the tone intensity produced by the Galton whistle, falls completely within the limits of this instrument; the curve obtained from the low tuning-fork of Appunn, however, representing the lower tone-limit, shows us at the first glance that we have not reached the lower tone-limit of the normal human ear with the 16 vibrations of this fork, for in this instance the curve stops suddenly at its highest point, although we should expect, with certainty, the unequal prolongation of the curve in both directions to the zero line, as has been exhibited in both other curves for the upper limit.

MISCELLANEOUS NOTES.

BRITISH MEETINGS OF SOCIETIES.

MEDICAL SOCIETY OF LONDON.—At the clinical evening on January 30th, Mr. Lockwood showed a case of symmetrical gangrene of the auricles, simulating Raynaud's disease. The condition was not the result of frost-bite, but the pupils were sluggish and unequal, suggesting a trophic nerve lesion. The question of treatment was discussed by Mr. Marmaduke Sheild, Drs. Cautley, Guthrie, and Eddowes, and the president [Mr. Hutchinson] made some remarks on causation and the value of small doses of opium.

WEST LONDON MEDICO-CHIRURGICAL SOCIETY.—At the clinical meeting held on December 2, 1892, Mr. Richard Lake showed a boy aged six, on whom he had operated for cholesteatoma of the mastoid antrum penetrating the posterior fossa of the cranium. The recovery was uninterrupted.

ROYAL ACADEMY OF MEDICINE IN IRELAND—SURGICAL SECTION.—Mr. Doyle brought forward two cases of disease of the mastoid and petrous portions of the temporal bone in connection with diseases of the ear. In one case a direct communication had been formed with the middle fossa of the cranium, producing softening and abrasion of the under surface of the temporo-sphenoidal lobe.

BRITISH LARYNGOLOGICAL AND RHINOLOGICAL ASSOCIATION.—At the quarterly meeting held on December 9, 1892, Dr. Milligan showed a patient on whom, by his advice, Mr. Thorburn had laid the left nasal cavity freely open and removed a large sarcomatous mass attached to the middle turbinated bone. Twenty years ago, and again seven years previously to the present operation, nasal polypi had been removed, and Dr. Milligan raised the question as to whether the malignancy of the growth was not in some way dependent upon the irritation consequent

upon these operations. The patient was a single woman aged forty-five. In the discussion which followed, Drs. George Stoker and Sandford, and Mr. Bark of Liverpool, related somewhat similar cases of recurrent nasal growths. Dr. Milligan also showed a case of malignant disease of the tonsil in a man aged forty-nine.

At the annual meeting held on December 10th Professor Von Schroetter of Vienna and Dr. F. H. Bosworth of New York were unanimously elected honorary members.

MANCHESTER MEDICAL SOCIETY.—At the meeting held on November 16, 1892, Dr. Milligan made some observations upon excision of the auditory ossicles in cases of chronic suppuration of the middle ear. He claimed for this proceeding that it enabled him (1), to rid the tympanum of the focus of disease and secure thorough drainage, and (2), to improve the hearing. A case was shown in which marked improvement had resulted.

MANCHESTER CLINICAL SOCIETY.—At the meeting on December 20, 1892, Dr. Milligan showed several patients suffering from naso-pharyngeal adenoids, and a discussion upon several points connected with the condition ensued. Dr. Milligan considered that the disease should be looked upon as the local manifestation of a dyscrasia closely allied to scrofula, and advocated early removal.

ANDERSON'S COLLEGE MEDICO-CHIRURGICAL SOCIETY.—At the meeting held on December 10, 1892, Professor MacIntyre M.D., read a paper on diseases of the throat and nose.

NORTHUMBERLAND AND DURHAM MEDICAL SOCIETY.—At the meeting on November 10, 1892, Dr. Robertson showed two cases in which he had drained the antrum of Highmore on each side for old-standing disease with good results.

BRITISH MEDICAL ASSOCIATION.—The annual meeting will be held at Newcastle-on-Tyne on Tuesday August 1, 1893, under the presidency of Dr. G. B. Philipson, Professor of Medicine in the University of Durham, and senior physician to the infirmary.

Arrangements have this year been made for a separate section in Otology, of which Mr. H. B. Hewetson of Leeds has been appointed president; Mr. R. Ellis and Dr. Bronner, vice-presidents; Dr. Mackenzie Booth of Aberdeen and Mr. Macaulay of Newcastle, honorary secretaries.

The following special subjects have been proposed for formal discussion: 1. *The Surgical Treatment of Mastoid Disease and its*

Complications. To be opened by Professors William Macewen, M.D., Glasgow; Victor Horsley, F.R.S, London; A Ogston, M.D., Aberdeen; and Dr. Guye, Amsterdam. 2. *Pathogenic Organisms of the Naso-Pharynx and Ear.* To be opened by Dr. Macintyre, Glasgow.

YORKSHIRE BRANCH.—At the meeting held at Harrogate on November 2, 1892, Dr. Adolf Bronner read a paper on "Some Common Diseases and Tumors of the Naso-Pharynx."

SOUTHEASTERN BRANCH—WEST KENT DISTRICT.—At the meeting held at the Kent and Canterbury Hospital on November 24, 1892, Dr. T. Eastes of Folkstone read a paper on post-nasal adenoids, insisting upon the importance of early removal and recommending the use of forceps, supplemented by scraping with the finger nail.

ROYAL COLLEGE OF SURGEONS.—The Bradshaw lecture on the surgery of the nose and accessory cavities delivered by Mr. Christopher Heath of the Royal College of Surgeons on December 1, 1892, is not remarkable for any particular novelty with regard either to the pathology or treatment of the affections referred to. It is chiefly noticeable for the fact that Mr. Heath took the opportunity of deprecating the work of those who had devoted particular attention to this particular subject, and of expressing the somewhat astonishing opinion that the general surgeon "owes little or nothing to the specialist"!! It is of course extremely easy to make such assertions as these, more especially when there is not any danger of the lecture being subjected to the rigors of debate and discussion.

An ingenious ear syringe is depicted in the *Lancet* of December 24, 1892, by Messrs. Wright & Co., of New Bond Street. The syringe is of the ordinary "ball" pattern, and its main features appear to be that the nozzle is very short, and consequently cannot be thrust too far into the meatus, and it is also furnished with an ingenious arrangement for securing a return flow of the fluid injected.

The Spring term of the London Post-Graduate course commenced on January 16th and terminated on March 11th; it in-

cluded a series of lectures and demonstrations at the London Throat Hospital by Drs. Whistler, Law, and Woakes, and Messrs. Stewart and Stoker. The Summer term commences on May 1st, and ends on June 24th.

APPOINTMENTS.

BARRON, B. J., M.B., has been appointed physician to the throat and nose department of the Bristol General Hospital, Eng.

FULLARTON, R., M.D., appointed lecturer on diseases of the throat and nose at St. Mungo's College, Glasgow, Scotland.

LITTLE, A., M.B., C.M., appointed ophthalmic and aural surgeon to the Victoria Hospital, Burnley, Eng.

MILLIGAN, W., M.D., has been appointed lecturer on diseases of the ear at Owens College, Manchester, Eng.

PAN-AMERICAN MEDICAL CONGRESS.

SECTION ON OTOLOGY.

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Book Reviews.

Lehrbuch der Ohrenheilkunde. By A. POLITZER. Dritte gänzlich umgearbeitete Auflage. 619 pages, 331 illustrations. Stuttgart: F. Enke, 1893.

The third German edition of Politzer's famous text-book is most carefully revised and extensively re-written. The author, whose merit in the development of modern otology is unexcelled by any one man, has personally cultivated every part of this special field (the dimensions of which are so rapidly extending), and followed the progress of its growth most conscientiously. This shows on every page. In many text-books the first edition only is brought up to date, and the more editions follow, the more behind-times the book is apt to become. Such is not the case with the work under consideration. The ambitious author, whose working power is astonishing, omits no opportunity to remain the first in the rank. For this reason, the present edition of his text-book appears the clearest, truest, and most complete presentation of the actual state of otology. The book is sure to hold the ground even in competition with the forthcoming cyclopedia of Schwartze, for a work of one author, who masters the whole field, has the advantage of conciseness, uniformity, and harmonious treatment of the subject.

H. K.

New York Eye and Ear Infirmary Reports. Vol. I., part 1. Jan., 1893. G. P. Putnam's Sons. Price, $1.25.

The N. Y. Eye and Ear Infirmary, the oldest and largest institution of its kind in America, shows its progress not only in the increase of its charitable work, but also in placing the medical experience it furnishes to its staff, students, and visitors at the

reach of the profession at large, by publishing, at irregular intervals, a collection of papers based on observations and investigations made in the hospital and laboratory. The first number, consisting of seven ophthalmological and seven otological papers (which will be analyzed in our systematic report on progress), introduces the publication with the following statement:

"The Surgical Staff of the N. Y. Eye and Ear Infirmary, desiring to make known the professional work of the several departments of the Institution, have decided to publish a small volume of original articles which will appear at intervals as material shall be collected.

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The increasing number of valuable papers offered to us makes it impossible to publish in an unabridged translation all articles of the one edition in the other. In the future all papers of the one will be announced in the other as soon as they have appeared, and translated as soon and as extensively as practicable. Those of our readers who, for parallel examination, verification of certain statements, or minute study, desire to recur to the original, will have a loan-copy sent to them by applying to one of the editors (S. Moos, Heidelberg, for English originals; H. Knapp, 26 West 40th Street, New York, or U. Pritchard, 3 George Street, Hanover Square, London, for German originals).

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